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ABSTRACT

This report is an evaluation of the Integrated Science Program for undergraduate students at Northwestern University. Four aspects of the program were investigated: (1) history and development, (2) curriculum, (3) effect on students' attitudes and behaviors, and (4) the impact of the program on students' careers. Recommendations for future action are given. Three appendices contain a sample brochure and application to the program, a copy of the curriculum, course evaluation and summary questionnaires, and the student survey. (SA)

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AN EVALUATION OF THE INTEGRATED SCIENCE PROGRAM

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FINAL REPORT

June 1979

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PREFACE

This report presents an evaluation of Northwestern University's Integrated Science Program (ISP). The evaluation of higher education courses, especially an entire curriculum, was a new venture for us. As it turned out, our attempts to locate pertinent literature in this area confirmed that this was generally unexplored terrain. Although education is perhaps the oldest area of evaluative concern, the systematic assessment of entire programs has only recently received attention. Thus this report breaks new ground, not only personally but for the evaluation community as well. It is our sincere hope that the path we have blazed--the general perspective, the methods, design, analyses, and even the mistakes--will be helpful to those who next travel this way. To those interested in the substance of ISP as a potential program for adoption, we also hope to have provided a clear map for establishing and conducting such a program.

The evaluation was conducted over a three-year period from September, 1976 to May, 1979. Support for this work was provided as part of the funds awarded to ISP by the National Science Foundation's Alternatives in Higher Education Program. We hope that the evaluation addresses important issues in the funding of such programs. However, we must caution the reader that ISP is still a rapidly evolving program, and that the results presented here must be viewed in this context. While we believe the findings are instructive, they are in no way definitive. In particular, we do not and cannot address the crucial issue of external validity. Whether or not the program will work at Slippery Rock, or Harvard for that matter, is beyond the scope of our findings. Nevertheless, we do believe that we have identified a number of factors that are crucial to the success of such a program.

SUMMARY

This is a report of an evaluation of Northwestern University's Integrated Science Program (ISP). ISP is an undergraduate program begun in 1976 that provides an accelerated interdisciplinary education in science and mathematics to intellectually superior students. The program lasts only three years with a B.A. in science awarded upon completion. The major goal of ISP is to produce "panscientists" interested in pursuing advanced postgraduate training in the newly emerging integrated sciences such as astrophysics, biochemistry, and geological sciences.

The evaluation was conducted over the three academic years 1976-77 to 1978-79 with support provided from the funds awarded to ISP by the National Science Foundation's Alternatives in Higher Education Program. It involved four basic components. First, the history and development of the program were documented by a series of extensive interviews with relevant faculty and administrators. This was done so that others interested in developing such a program could appreciate the organizational factors necessary to implement it. Second, the curriculum was evaluated. While the major focus of this effort was to provide formative feedback useful for program improvement, the emphasis here was on assessing the curriculum as a whole. Third, the effect of ISP on student's attitudes and behaviors was evaluated with special consideration to program dropouts. Finally, the impact of ISP on student's careers was investigated through interviews with the first graduating class and a survey of leading graduate programs. The results are briefly described in the following sections.

History

As early as 1969, Dr. Lawrence Sloss, then Chairman of the Geological Sciences Department, proposed to the Division 1 (natural sciences) Council of the College of Arts and Sciences (CAS) at Northwestern that a basic curriculum be established for the division. The proposal was rejected by the Council. The idea was reintroduced from time to time by Sloss and his successor, Dr. Fred Mackenzie. Finally, in January, 1974, the Council decided to investigate the possibility of establishing an integrated science curriculum and a Study Committee was commissioned by then Dean Hanna Gray, with Sloss as chairman.

The committee consisted of representatives from all the departments in Division 1, all of whom were chosen on the basis of expressed interest in creating such a program. In its report of June, 1974, the committee agreed that the basic idea of an integrated science program was a sound one. They recommended that another committee develop a curriculum and address the questions raised by such a program.

Dr. Rudolph Weingartner, the new Dean of CAS formed a second Study Committee in July, 1974, chaired by Dr. Robert Speed of Geological Sciences. In its report of October, 1974, the committee recommended that a new Integrated Science Program (ISP) be established for a minimum evaluation period of three years and that a Director be appointed to handle administrative affairs. The report dealt with a number of issues raised by ISP such as its educational objectives, curriculum, degree options student recruitment and funding.

The proposal for the formation of ISP was approved by Division 1. Dr. Speed presented the proposal to CAS three months later, where it was approved. In March, 1975, Dean Weingartner appointed Dr. Speed as the first Director of ISP with an advisory committee of representatives from the Division 1 departments.

A formal proposal was submitted by Speed to the National Science Foundation (NSF) in July, 1975. A year later support for the first three years of the program, totalling $418,000, was granted by NSF.

The recruiting campaign began in September, 1975. It involved extensive mailings to mathematics and science teachers at selected schools, and to science-oriented students as well.

Curriculum

The largest component of the ISP evaluation focused on the curriculum. The major question addressed in this section of the report concerned the overall effectiveness of the ISP curriculum. Unlike the early, formative phase of the evaluation which focused on improving individual courses, this summative component of the project considered the curriculum as a whole.

This was accomplished by examining a set of course-specific (as opposed to teacher-specific) items on a Course Evaluation Questionnaire (CEQ) as well as a Summary Questionnaire assessing the integratedness of the ISP curriculum. Both these instruments were administered at the end of each quarter. The data from the second year of ISP was used in the analysis.

Two sets of comparison courses were identified with the assistance of the ISP staff: general science and advanced or honors courses. Only chemistry, mathematics, and physics courses were used since they accounted for all freshmen and most sophomore ISP courses, and had similar, non-ISP counterparts.

The mean ratings for all ISP courses were favorable with most items (statistically) significantly greater than the neutral point on the rating scale. The ISP curriculum was also rated more highly than comparable general science and advanced courses. However, when examined by discipline, a stable pattern emerged with ISP mathematics courses consistently rated more highly than non-ISP math courses while the ISP chemistry courses were not rated as highly as their non-ISP counterparts. The ratings for the physics courses were mixed with some ISP courses being more highly rated and others not. This pattern held for freshmen and sophomores, general and advanced courses, and for the integratedness of the courses as well. These findings reflected both the central role played by mathematics in the ISP curriculum and the problems encountered with the chemistry courses during the first years of the program.

A separate study was also conducted to determine whether the course ratings reflected differences in the grades between ISP and other Northwestern students. It was found that ISP students, in fact, received slightly lower grades than non-ISP students. These results were not statistically reliable nor were grades often mentioned on the ISP course evaluation comments.

Students

This section of the evaluation examined the effects of ISP on the students. It presents the results of ISP's recruitment efforts, the attitudes and behaviors of both ISP and non-ISP students, and the reasons for students leaving ISP.

ISP has been quite successful in atracting bright students to Northwestern. While most of them come from the Midwest, they average almost 100 points higher on the college boards than the typical entering NU freshman. About half of those admitted to the program enroll and those who do not accept often enroll at other highly regarded academic institutions.

In order to determine the effect of ISP on student attitudes and behaviors, an extensive questionnaire containing 89 items was administered each spring to all ISP students and each fall to ISP freshmen as well. This ISP Student Survey was composed of 10 separate sections eliciting information on students' use of university facilities, interaction and attitudes toward the faculty, psychological climate, allocation of time, and attidues toward ISP.

A slightly modified version of the questionnaire was administered to a similar group of non-ISP students. The 40 scaled items common to both questionnaires were collapsed into eight new variables through the use of factor analysis.

For ISP students the lounge especially provided for the program proved to be the most heavily used facility. Not surprisingly, non-academic activities and facilities were not utilized often.

There was little interaction between ISP students and faculty. In particular, there was little contact with their advisors despite some attempt to structure regular contact. On the other hand, as the course evaluations indicate, students were quite satisfied with their instructors, and the superior academic quality of the program was rated as most descriptive of the atmosphere within ISP.

Overall, students spend over 10 hours per day on academic activities, with over eight devoted to ISP. Consequently, ISP students spend a substantial portion of both their academic and non-academic time with others in the program. ISP students are together almost eight hours per day in class, study, and recreational activity. As a result, it appears that there is a substantial amount of group cohesiveness.

Those aspects of ISP that students found most satisfying were the small class size, the advanced and integrated curriculum, and the faculty. They were not satisfied with the advising system, the computer instruction, the lack of freedom in course selection and contact with non-ISP faculty. These latter criticisms pose a dilemma for ISP. Many students would like to explore other outside interests and feel restricted by the demands of the ISP curriculum while others want more flexibility within the program to specialize in an area more quickly than the curriculum allows. In particular, there is an interest in life sciences by those interested in medical research despite the faculty's view that ISP is not a pre-med program.

Over time, there are some changes in students' attitudes and behaviors. There is less contact with other ISP students outside of class and a concomitant decline in group spirit, less positive attitudes towards professors who are seen as more distant, and a decline in affection for the university. There also is increasing uncertainty over whether to obtain an advanced degree.

When ISP was compared to the educational experience of a similar group of Northwestern students not enrolled in the program, it was viewed quite positively. ISP was rated more favorably in terms of the personal qualities of the other students, interaction with others (both faculty and students), quality of instruction, and the ability to work with other students on academic problems. However, there was no overall difference between ISP and non-ISP students in the level of satisfaction with their education.

As was noted above, ISP was viewed less favorably in terms of freedom in course selection. Moreover, those changes observed over time were similar to the ones noted above. Again, the most significant negative finding concerned the lack of adequate faculty guidance. Nevertheless, ISP students maintain their enthusiasm for their educational program from their freshman to sophomore year while it declines for non-ISP students.

Attrition has been a significant problem in ISP with almost half of the students leaving the program before graduation. Interviews with students who had dropped out of ISP indicated that a change in career goals was the single most important reason for leaving the program. Most of these students were interested in applied topics such as engineering and were not committed to purusing post-graduate education. Other factors also involved in the decision to leave ISP were the heavy workload, problems with the curriculum especially with the computer training and chemistry, poor grades, and a dislike for the other ISP students.

The ISP Student Survey questionnaire was examined in an attempt to identify items that would predict student drop out. Not surprisingly the two items dealing with the students' satisfaction and enjoyment with their ISP experience (J1 and J2, respectively) along with two others concerned with non-academic time (A4 and E4b) proved to be good predictors (see Appendix D).

Given these findings, two recommendations were made. ISP should engage in more careful recruitment. In particular, the career goals of the applicants should be ascertained. Those who have very applied interests (including perhaps medicine) should not be admitted. Second, the advisory system has to be revived. Students do not have access to faculty for the advice and guidance they need. Other problems concerning curricular changes to allow more within program flexibility need to be and are being discussed, but go beyond the scope of this report.

Outcomes

Since this report was due shortly before the first ISP class graduated, two studies were conducted to assess the impact of ISP on their careers. The first involved extensive interviews with the first graduating class held in early spring of their last year. The second was a survey of the nation's leading graduate science departments focusing on the acceptability of ISP graduates and their interest in adopting a program like ISP.

The potential "greater appeal" of ISP to graduate schools was the least important program characteristic attracting students to enroll in ISP. As would be expected, the students were generally quite satisfied with their ISP education and the group cohesiveness fostered by the program. Most importantly, 10 of the 15 students definitely planned to take a fourth year at Northwestern, and only two planned to leave. All, but one, planned on post-graduate studies. However, only half had decided on a career. Only three students said that ISP affected their career choice by exposing them to other fields.

A brief eight-iterm survey questionnaire was mailed to 125 different highly rated graduate departments in 1977-78. A total of 103 departments (82%) responded. The overwhelming majority (85%) of these departments felt that an ISP graduate with the anticipated outstanding credentials would be admitted, and most would award financial aid as well. Overall, 87% of all respondents rated ISP as more than "adequate" as an undergraduate background for obtaining a Ph.D. with the average rating being "good." Over 40% felt that a program similar to ISP would be of value at their university, while only one quarter disagreed. The objections raised to ISP were program inflexibility, absence of laboratory experience, and independent projects. Mathematics departments tended to be the most critical feeling that students needed more advanced courses that could be obtained in a fourth year. Since most students in the first class were planning on a fourth year, this objection was likely to be met.

ACKNOWLEDGMENTS

This evaluation, which began over a casual lunch with Professor Robert C. Speed in the spring of 1975, has been aided by the cooperation, assistance, and guidance of many individuals. We would like to thank Professors Robert F. Boruch and Donald T. Campbell for their early encouragement and help in designing the evaluation. The project could not have been completed without the constant cooperation of the ISP faculty under the able leadership of Dr. Speed and his successor as Director, Professor Mark A. Pinsky. We are also indebted to Linda Brownell for her study of student attrition, Jon Soderstrom for his help with part of the analysis, and Professor David S. Cordray for his incisive comments and emotional support during the completion of this report. Finally, we owe special thanks to Mrs. Lucina Gallagher, administrative secretary for our Center, who, in addition to typing this report, handled those details too numerous to remember that are essential for conducting such a project. All of these people have helped improve the quality of this report. For those remaining infelicities of thought and prose we, ourselves, must be held accountable.

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1. OVERVIEW

The following chapters of this document present the results of an extensive evaluation of an innovative undergraduate curriculum at Northwestern University (NU) known as the Integrated Science Program or ISP, for short. The evaluation of ISP did not always resemble the final product contained in the remainder of this report, and it may be instructive for those engaged in similar efforts or the historically curious to glimpse the development of the evaluation. Thus this introductory chapter will present the history of the evaluation so that the observations noted below can be viewed from a wider perspective and with a deeper (perhaps more tolerant) understanding.

After our first meeting with the newly appointed Director of ISP, Dr. Robert C. Speed, in the spring of 1975, we were asked to develop a preliminary evaluation plan as part of a grant proposal to the National Science Foundation (NSF). Working with Professors Boruch and Campbell, an initial evaluation plan was written and included in the proposal submitted to NSF's Alternatives in Higher Education Program. Four evaluation approaches were proposed: (1) a comparative educational analysis, (2) a market research study, and both (3) a systems, and (4) a curriculum evaluation. The first two of these were to be conducted by the Psychology Department's Division of Methodology and Evaluation Research (and later its Center for Evaluation Research) under the direction of Dr. Paul M. Wortman.

Originally, the comparative educational analysis was to evaluate the education in science and mathematics provided by ISP relative to that offered by the traditional science curricula at Northwestern. This was to involve comparisons of both general science knowledge and mastery of specific information in the basic sciences. The study was predicated on our ability to create reasonable comparison groups for use in a quasi-experimental analysis. Groups considered were Northwestern-bound science students invited to join ISP after acceptance at the University; those NU students meeting ISP standards, but not invited to enroll in ISP; and finally those students enrolling at NU because of ISP.

Since almost all ISP students were recruited directly (see Sections 2.6 and 4.1), this design had to be revised. Where student comparisons were appropriate, students meeting ISP admission cirteria and taking science courses were used. The comparative analysis also was changed to take advantage of the mandatory course evaluation that occurred at this time. Instead of developing special questionnaires and instruments, the comparative educational analysis employed a slightly modified version of the University course evaluation form to assess the ISP courses. This allowed the ISP curriculum to be compared to a variety of similar courses as is described in Chapter 3. Thus the comparative educational analysis was related to the curriculum evaluation.

The curriculum evaluation, which was not initially to be conducted by the evaluation team, therefore became a primary focus of our evaluation. The emphasis of the curriculum evaluation, however, was on program monitoring or formative evaluation. This kind of evaluation focuses on program operation and feedback. During the initial phase of a new program, continuous feedback to the staff (i.e., faculty and administrators) is essential to allow the necessary adjustments, refinements, and improvements in the courses as quickly as possible. The rigorous evaluation of a program's overall impact, or summative evaluation, only becomes meaningful after a program has developed and is operating as originally envisioned.

With this in mind, a course evaluation questionnaire (CEQ) was designed (and, initially, refined on a quarter-to-quarter basis) for the primary purpose of providing the rapid formative feedback essential to program development. During the first two years of ISP (1976-78), we administered the CEQ for all ISP courses at the end of each quarter. The means and standard deviations for all questions with numerical ratings were computed along with a summary of all comments to the open-ended essay questions. This information was forwarded to the instructors, ISP director, the dean, the department chairman, and the University office in charge of processing course evaluations. In addition, the instructor was provided with the full list of student comments.

The first year of ISP (1976-77) was viewed as a developmental year requiring formative evaluation. For this and other reasons (noted below) the second year of ISP was used to conduct the summative curriculum evaluation described above. In addition to the CEQ, a Summary Questionnaire was administered each quarter to determine how integrated the basic science courses in mathematics, chemistry, and physics were. The intent, then, of this aspect of the evaluation was to move from an assessment of individual courses and instructors to an assessment of the program as a whole.

The market research study involved a questionnaire survey of the acceptability of ISP graduates and the transferability of the ISP principle to other universities. This plan remained constant over the course of the evaluation and is described in Section 5.3.

The last component of the evaluation originally proposed involved an assessment of ISP as a system. The purpose of this study was to understand "the reasons for the success and/or failure of the whole system and its components, chiefly for the edification of the national educational community." The design was at that time only "tentatively formulated" and was to be conducted by another group at Northwestern. However, due to fiscal limitations to be discussed below, this component of the evaluation was also conducted by the Center for Evaluation Research.

The systems analysis as developed by our team involved extensive interviews with both staff and students in ISP as well as other relevant members of the Northwestern community such as deans, department chairmen, and other faculty members. These interviews served a variety of purposes. First, they allowed us to document in some detail the organizational effort and processes necessary to establish a program like ISP in a university setting. This history is described in Chapter 2. Second, interviews were useful in understanding why students dropped out of ISP. A series of such interviews were conducted during the second year and are reported in Section 4.3 And finally, interviews can also be valuable in assessing the impact of ISP on those who remain in the program, especially on their career plans. This study was conducted during the third year with the first group of ISP graduates-to-be and is reported in Section 5.2.

In addition to these interviews, a questionnaire was developed to assess the impact of ISP on students' attitudes and behaviors. This so-called Survey Questionnaire was also administered to a comparable group of non-ISP students as noted above. The results of this study are presented in Section 4.2. Finally, a number of other analyses are also presented. These include the results of ISP's recruitment activities (in Section 4.1), and the impact of the ISP curriculum on student grades (in Section 3.2). Overall, the evaluation of ISP involved a variety of methods, designs, and analyses to trace its origins or history (Chapter 2), to determine the effectiveness of its curriculum (Chapter 3), and to assay its impact on students (Chapter 4) and their career plans (Chapter 5).

All of this depended on the availability of adequate funds, and fiscal constraints did effect the conduct of this evaluation. The initial request to NSF asked for $60,000 for the evaluation. Although NSF finally awarded $374,625 to support ISP during its first three years (1976-79), only $7,000 was available to pay for the evaluation. As a result, the first year of ISP involved quite limited evaluation activities conducted by a graduate student working part-time under the Center director's supervision. The work focused on developing a curriculum evaluation instrument and initiating the market research study.

In the spring of 1977 a reapplication for support of the evaluation was made to NSF. This time the request was granted and an additional $44,000 ($86,400 including indirect costs) was provided to conduct the evaluation over the two remaining years of NSF support. The funds were used to hire two graduate research assistants full time. However, since NSF funding was to end in May, 1979, before the first ISP class graduated, an additional constraint was placed on the evaluation. Because this document was due before the conclusion of the third academic year of ISP's operation, it was not possible to collect, analyze, and report on data from the end of that year. Nor were we able to obtain complete information on students' career plans. As a result, the general emphasis of the evaluation is on the second year of ISP. This was a fairly stable year for the program in which to conduct the summative evaluation of the curriculum. At least for ISP freshmen, the instructors and the courses were the same as the first year.

From our perspective there are a number of lessons to be learned from this experience. First, a program outcome or impact evaluation should have longer term support than is provided by project development funds. For a relatively small additional investment this can be accomplished for most projects including ISP. Second, it is important that evaluation funds be separated from project funds. NSF was most concerned about the independence and objectivity of an evaluation conducted by another part of the same organization. And yet, after they were reassured of our ability to conduct a thorough and unbiased evaluation, they placed the evaluation funds under the administration of the ISP Director. In all fairness to NSF, it should be noted that Northwestern, unlike many other universities, has not developed the necessary fiscal mechanisms for removing such funds for separate administration. While this, in our opinion, did not affect our judgment, it did result in numerous administrative problems.

In summary, the ISP evaluation presented in the remainder of this report is clearly the end product of an evolutionary process. Like most research studies, it developed in accordance with both social and fiscal dynamics. As the ISP program moved from theory to reality, the evaluation also came into sharper focus. Within this context, the availability of funds ultimately determined the form of the actual evaluation and the components selected.

2. HISTORY

2.1 Introduction

The Integrated Science Program (ISP) at Northwestern University was instituted in 1976 to provide an accelerated interdisciplinary education in science and mathematics for intellectually superior students. All seven natural science departments (astronomy, biochemistry, biological sciences, chemistry, geological sciences, mathematics, and physics) of Northwestern's College of Arts and Sciences (CAS) participated in all phases of the development and implementation of this program.

The primary goal of ISP is the establishment of a broad accelerated program leading to a B.A. in science within three years. However, a variety of options such as dual majors, late (i.e., in the sophomore year) entry, and a fourth year provide both flexibility and opportunity for specialization. All degree options are structured primarily to qualify ISP graduates for advanced study leading to the Ph.D. in mathematics and sciences. The development of a science program emphasizing breadth but also allowing opportunities for specialization presented a number of problems that were not easily or immediately solved. This report will attempt to identify and explicate the factors involved in the development of this innovative approach to undergraduate science education.

In order to reconstruct the history of ISP, personal interviews were conducted with the individuals involved in the planning and development of the program and CAS documentation for the years in question was consulted. The results of this inquiry illustrate many of the challenges that may face other institutions considering similar programs.

2.2 Origins of the Program

The concept of an integrated science curriculum emerged from a growing concern at Northwestern that overspecialization in the traditional scientific disciplines was making it less likely that talented students would enter the newly emerging interdisciplinary fields of science such as biochemistry and geological sciences. This situation was exacerbated by the requirement that students declare a major at the end of their sophomore year--a point at which they would have been exposed, almost exclusively, to the traditional sciences. As early as 1969 and 1970, Dr. Lawrence Sloss, then chairman of the Department of Geological Sciences, proposed to the Division 1 (natural sciences) Council of the CAS that a basic curriculum, emphasizing breadth of study, be established for the division. Initially conceptualized as a general program for all science students, the proposal was not found acceptable by the Council. By January, 1974, however, the Division 1 Council had recognized the need for small specialized programs aimed particularly at the more talented student, and a proposal for such a program, brought forward by Dr. Sloss's successor as chairman of the Department of Geological Sciences, Dr. Fred Mackenzie, was recommended for study by an _ad hoc_ Study Committee.

2.3 Program Development

The Committee, commissioned by then Dean Hanna Grey, was chaired by Dr. Sloss and included Drs. A. Louis Allred (CAS and Chemistry), Laura Bautz (Astronomy), Laurie Brown (Physics), Erwin Goldberg (Biological Sciences), Mark Pinsky (Mathematics) and Robert Speed (Geological Sciences). All were chosen on the basis of expressed interest in the creation of such a program.

In its report of June, 1974, the Committee agreed in principle that a program of this nature would be beneficial in both attracting talented students to Northwestern and meeting their needs once here. It recommended that a highly structured curriculum be established that was geared to advanced entering students with skills in mathematics (differential and integral calculus); advanced placement on at least six of the fourteen CAS arts and sciences requirements was also assumed as a prerequisite to this curriculum. In addition, the Committee recommended that several degree options be offered within such a program (see below) and concluded by calling for another Study Committee to develop a tentative curriculum and address the further questions raised by such a program.

Upon receipt of this report, Dr. Rudolph Weingartner, the new Dean of CAS, formed a second Study Committee, in July, 1974, chaired by Dr. Speed. The other members included Drs. Allred, Bautz, and Pinsky of the first Study Committee along with Drs. Donald Ellis (Physics), Robert Gesteland (Biology), and Neil Welker, (CAS Associate Dean, Biochemistry). In its report of October, 1974, this committee recommended that Division 1 adopt a new integrated science program as defined for a minimum evaluation period of three years, and that a Director be appointed to handle administrative matters, including the recruitment of students and the search for outside funding. This report was approved, at that time, by Division 1, and the program itself was approved by the College of Arts and Sciences in January, 1975.

The report of the second Study Committee dealt with a full range of issues raised by ISP, including its educational objectives, curriculum, degree options, student recruitment, and funding. The first three of these were discussed in some detail, while the last two were addressed only in principle.

Recognizing that the number of the students in ISP would be relatively small (e.g., about 30 new students a year, for a total of 90-100 at any time) and that they would represent a highly selected group of intellectually gifted scholars, the Committee did not hesitate to recommend a broad spectrum of educational objectives, many of which might be regarded as mutually contradictory for less talented students. Thus, the Committee stressed the need for both educational depth and scientific breadth; it asked that the program both train students within the specific discipline, yet provide for maximum career flexibility. It also urged that several specific provisions for peer interaction be made, on both educational and personal levels. For example, the proposed curriculum provided for weekly seminars to foster group interaction, permit presentation of student reports, and allow for additional contacts with other members of ISP and related disciplines. Perhaps more importantly, it recommended that, subject to availability of funds and resources, special facilities for ISP students be provided on campus.

With regard to recruitment and funding problems, the Committee stressed that ISP was to be viewed as an innovative program for a selected group of advanced students, with very high admission standards. The unique nature of the program itself was viewed as a strong source of group cohesiveness, tending to motivate students in the program beyond customary levels. Maintaining such a high motivational level would clearly require both the talents and enthusiasm of dedicated staff, as well as a full range of facilities, and the committee recommended that outside funding be sought to increase the scope of the program beyond the capacities of the limited University budget.

As envisioned by the committee, the basic structure of the curriculum would consist of a four-quarter core sequence emphasizing rigorous presentations of mathematics, physics, and chemistry. Materials presented in any of these areas during any quarter should be maximally integrated across the disciplines: thus, in the first quarter, students would be considering vector problems in mathematics, applications of these problems (e.g., vector kinetics, momentum, and free-body problems) in physics, and related applications (e.g., chemical kinetics, bonding) in inorganic chemistry. Similarly, in the second quarter, mathematics would stress work in fields and surfaces, leading directly to applications in physics (electromagnetic fields, electrostatics, electric potential), and providing a foundation for concepts of organic chemistry.

After the initial four-quarter core sequence, the curriculum would branch into four derivative sequences: life sciences, physical sciences, mathematics and modern physics, as well as allowing, in the third year, several further liberal arts options. Concurrently, a one-credit per year seminar was proposed (regular courses are 3 credits each) that would provide additional opportunities for integrating and interrelating the various materials.

Finally, the committee also recommended the appointment of a full-time Director for the program; an advisory committee, consisting of representatives of departments involved in ISP to provide liaison with those departments; and a full-time secretary. In addition, the committee recommended that a means of monitoring and evaluating the progress of ISP be established.

As noted, this proposal met with the immediate approval of Division 1 of the CAS; and, when reformulated by Dr. Speed for presentation to the full CAS, was approved by that body three months later. In March, 1975, Dean Weingartner appointed Dr. Speed as director of ISP, with an advisory committee consisting of Drs. Gesteland, Pinsky, Sloss, Welker, Mark Ratner (Chemistry), and Paul Auvil (Physics).

2.4 Funding

In keeping with the second Study Committee's recommendation that ISP seek external funding, several sources were investigated, including the NSF's Alternatives in Higher Education program, Exxon Foundation, General Electric Foundation, the Lilly Endowment, and the Sloan Foundation. A formal proposal was submitted to NSF in July 1975, and support for the first three years of the program, totalling $418,000, was granted a year later. Most of the funds (over 90%) were used for faculty, with smaller amounts providing secretarial expenses, travel, equipment, and evaluation costs.

2.5 Degree Options

There were six different degree options and transfer possibilities specified by the second Study Committee that are currently available. Since this report is being submitted just as the first ISP students graduate, only preliminary information is available on how many and which of these options will actually be chosen by ISP students (see Chapter 5, Section 2). The options include:

1. Three year ISP degree: B.A., in science

2. Dual major: ISP degree with B.A. in departmental major. Since ISP is an accelerated three-year program, departmental requirements can be met in the fourth year.

3. Dual major: ISP degree and interdisciplinary or ad hoc major; that is, for programs for which formal course requirements have not yet been established.

4. Combined B.A.-M.S. programs; the Master's degree can be obtained in the fourth year.

5. Late entry into ISP: transfer is possible up to the beginning of the second year, without exceeding the normal four-year span.

6. Transfer to departmental majors: students can transfer out of ISP at any point.

Beginning in 1976, ISP students applied separately to the University for three-year B.A. status. As of May, 1978, all ISP students have a waiver automatically granting them three-year status. Since ISP is an entirely new program and firm evidence of its acceptability to graduate schools has yet to be shown (see Chapter 5, Section 3), students planning to continue onto graduate schools in the sciences are encouraged to complete a fourth year concentrating on their chosen areas of specialization. Those who have chosen to leave after three years appear to be oriented primarily to the biological sciences including medicine. (A brief discussion of these issues, focusing on the first graduating class, is also presented in Section 5.2).

2.6 Student Recruitment

Since ISP was designed as a limited program to be made available to a small group of intellectually superior students, the advisory committee decided to set high admission standards. This was done not only to recruit the type of student who was most prepared for such a program, but also to attract superior students to Northwestern.

Students are expected to have taken four years of English in high school, at least two years of a foreign language, four years of mathematics including one year of calculus (mandatory), three years of science (with chemistry mandatory) and two to four years of history and social science. In addition, applicants must have an SAT quantitative score higher than 700; a high SAT verbal score; high rank in high school graduating class, and high grade point average; evidence of additional effort in science beyond the classroom experience; and strong letters of recommendation. Professor Speed indicated that, since the high school grade point average and SAT quantitative scores were high for nearly all the candidates, he paid close attention to the SAT verbal score, which was considerably more variable. In choosing among applicants who seemed equal with respect to aptitude for and interest in science, Speed favored those who had shown evidence of high competence in other areas as well (see Section 4.1).

Students meeting these requirements can enter ISP directly in their first year, or transfer into ISP from other programs at Northwestern or other universities. Late entry into ISP is feasible at the end of the first year since all ISP courses are completed within three years.

In order to attract prospective students, the Admissions Department at Northwestern directs three major recruiting efforts: a fall mailing of the ISP brochure (see Appendix A) to science and mathematics chairmen at about 8000 selected secondary schools with strong science programs across the country; a similar mailing to the approximately 10,000 students who express an interest in science on the CEEB tests; and five on-campus programs for prospective students and their parents. The ISP brochure briefly describes the program, majors and degree options associated with

ISP, qualifications for ISP, application procedures, financial aid, the facilities, and the ISP course sequence as well as the benefits of the multidisciplinary approach of the program. Included in the brochure is a card which the student may fill out to receive an application form (see Appendix A) and/or additional information about ISP.

In addition to these University efforts, the Director of ISP maintains a list of science teachers across the country from whom he solicits candidates. Prospective students suggested by these teachers also receive program descriptions and application forms. There are no systematic contacts between the ISP faculty and prospective students. If the student visits the campus, the Director generally has a short chat with him and sends him to sit in on a first year ISP math or physics class. The ISP staff does not visit high schools, make presentations, or do any further advertising for the program than is done by the Admissions Office.

Directors Speed and Pinsky have been in charge of admission to the program -- Professor Speed for the first two years of the program and Professor Pinsky for the third year. Applications are sent to ISP by prospective students at the time they apply to the University. There have been several instances of students interested in science getting information about ISP after applying to Northwestern, but this is generally not the case. The Director of ISP reviews the applications and ranks them.

Initial ranking of candidates for ISP is typically completed in March, and offer letters are sent to selected candidates by the middle of that month at the same time as general University admissions. Depending on acceptances, further offers may be made until the quota of 30 students for the incoming class is reached.

2.7 Curriculum Development and Teaching Arrangements

A broad outline for the ISP curriculum was developed by the first Study Committee and later details elaborated by the second Committee. With only minor changes, this model has been retained throughout the actual implementation of ISP (see Table 2-1). The evaluation of the curriculum is discussed in Chapter 3 of this report.

As presently established, ISP requires a minimum faculty of nine, each teaching three courses per year. Since the nature of the program places more than average emphasis upon the enthusiasm and dedication of the faculty, volunteers for ISP were recruited in consultation with departmental chairmen and the Dean of CAS. ISP faculty were almost entirely supported by NSF funds during the first three years of the program. These funds compensated the departments involved for the "release time" from other teaching responsibilities granted the ISP faculty by the Dean.

In addition to curriculum, degrees, and faculty, Northwestern University has also designated the upper floor of Dearborn Observatory for the exclusive use of ISP. This floor houses the office of the Director, classroom space, and a comfortable lounge for ISP students. A computer terminal is also available. It was felt that the availability of these designated ISP areas and facilities would contribute to the development of a homogeneous program for the students, and aid in the formation of group cohesiveness and interaction. On the other hand, the ISP advisory committee did not feel it was appropriate to extend this policy of academic exclusiveness to the students' residential life and thus did not endorse a special ISP dormitory. (These aspects of ISP are discussed further in Chapter 4).

Table 2-1

ISP Curriculum

	Fall Quarter	Winter Quarter	Spring Quarter
ar One	Math X1 (B91 - 1) Multidimensional calculus Physics X1 (A25-1) Mechanics Chemistry X1 (A78-1) General chemistry Liberal Arts	Math X2 (B91 - 2) Vector differential operators and ordinary differential equations Physics X2 (A25 - 2) Electricity and magnetism Chemistry X2 (B18-1) Organic chemistry Liberal Arts	Math X3 (B91 - 3) Systems of differential equations, linear algebra, and infinite series Physics X3 (A25 -3) Waves and oscillations Chemistry X3 (B18 - 2) Organic chemistry Liberal Arts
ar Two	Math X4 (C91 - 1) Boundary value problems Physical Science Y1 Geology (C15 - 0) Physics and chemistry of earth (the solid earth) Chemistry X4 (C48-0) Physical chemistry Liberal Arts	Math Y1 (C91 - 2) Functions of a complex variable Physics Y1 (C36 - 1) Quantum mechanics Life Sciences Y1 (Biochemistry C02) Principles of biochemistry Liberal Arts	Math Y2 (C91 - 3) Probability and statistics Physics Y2 (C37 - 0) Solid-molecular-atomic physics Life Sciences Y2 (Biochemistry C03) Physical and mathematical biochemistry Liberal Arts
ar Three	Physics Y3 (C38 - 0) High energy physics Life Sciences Y3 (Biology C10) Cell biology and physiology Liberal Arts Liberal Arts	Physical Science Y2 (Physics C-31) Astrophysics Life Sciences Y4 (Biology C11) Biology of perception and memory Liberal Arts Liberal Arts	Life Sciences Y5 (Biology C12) Population biology and evolutionary theory Liberal Arts Liberal Arts Liberal Arts

X courses are core sequence
Y courses are advanced sequences

2.8 Departmental Attitudes Toward ISP

In general, a program such as ISP can benefit individual departments in two different ways: first, in terms of what it contributes to the University as a whole and second, in terms of what it contributes to any department individually. Departmental attitudes toward ISP may be expected to vary depending on how these two factors are perceived.

In terms of ISP's value for Northwestern generally, it is clear that a program of this nature can do much to enhance the national reputation of the University in undergraduate science, and thus aid, at least indirectly, in attracting new funding, high caliber faculty, and, perhaps most importantly and immediately, more talented students. Moreover, the existence of an integrated science program at Northwestern can provide both a catalyst and an opportunity for the development of other interdisciplinary courses and programs, and allow for the expansion of interdepartmental studies.

At the departmental level, the primary benefits of such a program would appear to lie in its provision of outstanding undergraduate students and their potential for developing into graduate students within the department involved. With these considerations in mind, individual departments have viewed ISP in somewhat different fashions, depending on its importance to their perceived needs.

From its inception, ISP has received its most consistent support from the Department of Geological Sciences, since it is, itself, largely an interdisciplinary field, drawing widely on mathematics, physics, and chemistry as pre-requisites to further training in geology. This department had the most immediate incentives for supporting ISP in terms of its relevance to their needs, as well as its potential for developing students prepared for graduate work in geology. For slightly different reasons, mathematics and physics have also been strong supporters of ISP, viewing it primarily as a means of providing interdisciplinary breadth to students possessing basic mathematical and physical skills and goals. The Mathematics Department supported the program even though they did not expect to gain graduate students from it. The faculty felt that it was a good idea and the department would like to see it grow. The Physics Department's main incentive was the hope of getting good undergraduate students to transfer out of ISP or to choose a dual major in physics.

The immediate goals of providing better students as dual majors or potential graduate students have been less compelling for chemistry, biology, and biochemistry. Some members of these departments have suggested that ISP is weighted too heavily in favor of the physical and mathematical sciences, and have seen less potential for the implementation of their own interests in the program. This has been most pronounced in the case of biochemistry, which does not appear in the curriculum until the latter part of the second year. Nevertheless, the initial ambivalence felt by members of these departments with regard to ISP, appears to have diminished now that they too have become actively and directly involved in the program. In fact, contact with ISP students has produced favorable attitudes toward the program and heightened interest in recruiting them as majors.

2.9 Problems Encountered

In reviewing the initial guidelines offered by the second Study Committee in outlining the Integrated Science Program, it is apparent that both the overall goals and the specific means advocated by that committee have proven to be viable and valuable recommendations. The program has, indeed, come to life almost exactly as it was planned. This is not to deny, of course, that several problems have been encountered in the implementation of the program, and that, in all probability, other problems will be encountered at later stages in the growth of ISP.

Perhaps the most fundamental of these concerns the issue outlined in the preceding section. ISP has attempted to achieve its integrated character primarily by building its curriculum around a mathematics-physics-chemistry core, and this has led to a measure of competitiveness both between these disciplines and the others represented in ISP, and within these disciplines themselves. Thus, as noted, biochemistry was initially somewhat reluctant to invest heavily in ISP since its direct involvement lay, at that time, some years in the future. Similarly, biology, which is introduced only after the core years, has tended to feel that earlier emphasis on biological study would improve the integratedness of the program. And again, chemistry, although acknowledged as a member of the core triumvirate, has felt that its role was being slighted relative to mathematics and physics. This factor, combined with the feeling of the department that it was quite competent to find high-caliber students on its own, also led to some initial reluctance to participate as fully in ISP as it might have done.

It should also be borne in mind that ISP is structured to call for above-average involvement in teaching from its faculty: since this is not the path that leads most directly to academic advancement, a certain measure of reluctance on the part of all faculty to commit their full energies to this program cannot be seen as surprising. As a result, most of the faculty involved in ISP have been senior faculty members, who are no longer concerned with attaining promotions.

Other problems have also been encountered on the direct level of implementation of the program. For example, during the first year the faculty tended to overestimate the amount of material students could handle in a given length of time. While ISP students were intellectually quite advanced, their maturity and motivational qualities still led them to encounter difficulties with note-taking and long hours of study. Similarly, grading became a problem, revolving around the issue of whether ISP students should be graded on the same (normal) scale as other students, or be given more generous grades to reflect their advanced standing and heavier workloads. (This issue is discussed in more detail in Chapter 3, Section 3, of the present report.)

Another problem has been encountered on the level of recruitment. Since ISP is a novel program, more time and effort is required to define it to high school students than need be expended on more traditional programs. This problem, too, should resolve itself in a few years. At that time, it is hoped, students will no longer need to be recruited, but will be recruiting themselves into what will, at that time, have become an established program (similar to that in Honors Medicine) at Northwestern.

2.10 Essential Factors In Developing An Interdisciplinary Program

What is needed to achieve such innovative, interdisciplinary educational ventures as ISP? In reviewing the, albeit brief, history of this program at Northwestern, and by consulting those most intimately concerned with bringing it into being, it is possible to isolate several factors that seem to have contributed to the formation of this program.

The characteristics most commonly cited by the participants in the program were those of enthusiasm and dedication on the part of an administrator, who would ideally possess enough breadth in science to be able to enlist the support of scientists in disciplines other than his own. Monetary support, and an effective recruitment program to attract the necessary students were also cited as key elements in the formation of a successful program. In addition, of course, such a program must be able to win the commitment of the University itself to see that the program is maintained. In this case, the enthusiastic support of CAS Dean Weingartner was crucial in obtaining administrative backing. It is equally essential for the program to have sufficient appeal to attract a range of faculty willing to devote themselves primarily to teaching and curriculum development, since no one individual can be expected to remain with a program of this nature over a long period of time.

While these elements may be fairly obvious, and not particularly different from characteristics one would expect of any successful program, the history of ISP at Northwestern suggests that other factors have also entered into the creation of the program, and illustrate the limitations of other approaches. For example, dedication and enthusiasm alone appear by themselves as insufficient to establish such a program, despite its worth, as the unsuccessful attempts in the years between 1969 and 1974 demonstrate. Various factors such as administrative leadership, changing educational attitudes from the 60's to 70's, the availability of funding, and the increased competition for fewer students were all very important.

Beyond this, ISP was fortunate in developing two other aspects of its program from the start. First, it was at all times thoroughly interdisciplinary, involving the full and open cooperation of all departments involved. And second, as a result of this cooperation, the initial formulations for ISP could be worked out in sufficient detail to provide a clear and compelling blueprint for implementation. Related to this, but conceptually on a quite different level, has been the emphasis of ISP on establishing an evaluation mechanism, which has perhaps managed, by its existence alone, to head off a variety of problems that might have developed had it not been so clearly evident throughout. Due to feedback from the evaluation, implementation problems have been discovered and corrected. The instructors have been made aware of the level of the students' abilities, while the students have become more aware of what the expectations of them are, and both have made adjustments.

Thus, it would appear that this combination of elements: close mutual cooperation in all phases; clear and detailed formulation of policy; and provision for constant monitoring, in combination with the dedication of the participants and effective University support, would represent the key elements designed to lead to the success of programs of this nature.

3. CURRICULUM

A major focus of the ISP evaluation was on the curriculum. The development of a new set of courses represents the most immediate and central aspect of the program, and the one that was most important to assess. In particular, the ISP staff was most interested in obtaining immediate feedback on their performance so that the curriculum could be improved. Thus the major thrust of the evaluation has been on the provision of this formative information (as noted above).

3.1 Course Evaluation

Questionnaire. This part of the evaluation involved the administration of a Course Evaluation Questionnaire (CEQ) for each ISP course at the end of each quarter. This form was developed during the first year (1976-77) and extensively revised in the subsequent year to provide maximal overlap with the University's Course and Teacher Evaluation Council (CTEC) Form which had been mandated that year. The CEQ consisted of 43 items using the same five-point response scale as well as four questions with variable response scales and three essay questions (see Appendix C). The first 22 questions were identical to the CTEC Form. As noted above, these questionnaires were designed to provide rapid feedback to the faculty and administration. This was given on a quarter-to-quarter basis in terms of means, standard deviations and response frequencies. In addition, the relevant faculty members received a list of all essay question responses; faculty chairmen and administration received summaries of these responses for all courses.

Questionnaire Administration. Northwestern's CTEC questionnaires are routinely administered in class at the end of each quarter. Students are asked to respond in terms of only one course at a time, and those absent on the day of administration are simply ignored. The ISP CEQ administration differed from these procedures in several ways. All three ISP course evaluation questionnaires were administered at one sitting along with the Summary Questionnaire and, when appropriate, the Survey Questionnaires as well. Extensive follow-up procedures were undertaken to insure that as many students as possible completed the questionnaires. Thus, the ISP and CTEC questionnaires differed somewhat in terms of content, administration, and sampling.

The net effect of these differences on the responses to the questions cannot be determined. However, it would appear that such differences should not have a great effect at this level of the individual items; and the one difference that could be evaluated (response rates) indicated only an average difference of 9% more ISP students responding than those in comparison courses (see below). If anything, the lower response rates for these non-ISP course comparisons probably are biased against ISP given the propensity of many instructors to hand them out under favorable circumstances (i.e., at one of the last classes rather than at the final exam.)

Comparisons. The major question that concerns this section of the report is "Was the ISP curriculum satisfactory?" There are two approaches to answering this question--one absolute and the other relative. Since the CEQ used a consistent scale (1-5) indicating satisfaction or dissatisfaction, it is possible to determine whether the students responded positively to the course by examining the mean responses of each class to the evaluation questions. Alternatively, one could assess the ISP curriculum by comparing it to other Northwestern courses, particularly those introductory science courses in chemistry, mathematics, and physics. This latter comparison was made possible by adopting an evaluation form similar to the one mandated by the University. The results of both approaches are presented below.

The comparison courses selected for these analyses were limited to the three 'traditional' disciplines of mathematics, physics, and chemistry. Other courses in Geophysics and Biological Science were not considered, both because they were not offered at the freshmen level, and were being offered for the first time in 1977-78. In general, an attempt was made to find two types of courses to compare to the ISP courses: a general science course within the same discipline, and, where possible, an advanced (or honors) course also in that field. Where more than one section of a particular course was available for comparison, the sections were chosen first on the basis of comparable class size (about 30), and then randomly selected from this set.

Since the ISP curriculum was designed as a sequence of courses, an attempt was made to find similar sequences for both general and advanced comparisons. This was possible for the advanced courses involving freshmen math, physics, and chemistry; and the general courses for freshmen physics. Such sequences, in Northwestern's calendar, are characterized by the use of the same instructor throughout the sequence (as in ISP) and by a similar prerequisite structure.

The majority of the course evaluation questions examine the performance of the instructor. Since the focus of this evaluation is on the overall program and not on specific people, those questions that provided global assessments of the course were used in the subsequent analyses. Specifically the following three questions were used:

Question 1: The course material was presented on too difficult level for me.

Question 2: I feel I learned a lot from taking this course.

Question 8: I am glad I took this course.

We expected that ISP students would rate their courses as: less difficult, more informative, and more satisfying.

ISP Curriculum Evaluation. The means on the three evaluation questions for the ISP freshmen courses in mathematics, physics, and chemistry taught during 1977-78--the second year of ISP--are presented in Table 3-1. These courses were being taught by the same faculty for the second time, and thus represent more developed, stable courses that had received formative evaluation. As can be seen from these results, the ISP courses are generally rated quite favorably. However, there are some differences among the math, physics, and chemistry courses. For freshmen, the average ratings for the math courses are superior to the physics course which are, in turn superior to the chemistry courses. All ratings for the math and physics courses are significantly different from the neutral (i.e., 3.00) point while only Question 2 is significantly better than neutral for chemistry (all $ps < .01$).

ISP compared to non-ISP Courses. Table 3-1 also contains the means for a set of similar non-ISP courses. These courses represent the general science curriculum (G) a student would probably take if there were no ISP courses available. The comparison courses were selected with the assistance of the ISP faculty. A number of advanced or honors courses (A) are also available and the data from these courses are also presented.

Table 3-1

Means of ISP Courses and Comparison Courses: Freshmen

	Fall			Winter			Spring		
	ISP	Comparison		ISP	Comparison		ISP	Comparison	
		G	A		G	A		G	A
Mathematics	B91-1	B14	B90-1	B91-2	B18	B90-2	B91-3	B19	B90-3
Question									
1	3.97	3.84$_{**}$	2.79$^{**}_{*}$	3.84	3.70$_{*}$	3.29*	3.92	3.41$_{**}$	3.33
2	1.57	2.53$_{**}$	2.32	1.80	2.37$_{*}$	2.14	1.96	2.88$_{**}$	2.22
8	1.60	2.53	2.26	1.64	2.15	1.86	1.96	3.24	2.22
Physics	A25-1	A35-1	A90-1	A25-2	A35-2	B90-2	A25-3	A35-3	
Question									
1	3.50	3.32	3.07	3.52	3.36$_{**}$	3.33	3.56	3.71$_{**}$	
2	2.14	2.41	1.54	1.84	2.74$_{**}$	1.44	1.92	2.48$_{**}$	
8	2.36	2.80	1.78	1.92	3.06	1.78	1.92	2.74	
Chemistry	A78	A03	A70	B18-1	B10-1	B18-1s	B18-2	B10-2	B18-2s
Question									
1	3.19	3.68**	3.31	3.40	3.62	3.49$_{**}$	3.38	3.45	3.52$_{*}$
2	2.24	2.24	2.23	2.08	1.84	1.64$_{*}$	2.21	1.89$_{**}$	1.66$_{*}$
8	2.48	2.68	2.27	2.64	2.19	2.11	2.75	2.13	2.22

Means of ISP Courses and Comparison Courses: Sophomores

Mathematics	C91-1	C16	C91-2	C10-2	C91-3	C30
Question						
1	3.43	2.65$_{**}$	4.12	3.11**	3.79	2.93**
2	1.91	2.85$_{*}$	1.82	1.84	2.59	2.32
8	2.05	3.05	1.94	2.32	2.42	2.86
Physics			C36	C30-1	C37	C33-1
Question						
1			2.69	3.08	3.60	3.60
2			2.19	1.62	2.27	2.10
8			2.69	2.15	2.60	2.60
Chemistry	C40-1	C40-1s				
Question						
1	3.86	3.13**				
2	1.91	1.93				
8	1.86	2.21				

**(p < .01)

*(p < .05)

s = same course as ISP.

A variety of nonparametric and parametric analyses were performed on the data. Generally, they yield the same pattern of results. Overall, ISP freshman courses are viewed more positively than the non-ISP general science courses. A Mann-Whitney $\underline{U}$ test of the combined ratings for the three questions was statistically significant ($U(9) = 20$, $\underline{p} < .05$ one-tailed) in the positive direction. A multivariate analysis also resulted in the same conclusion ($\underline{F}(3,10) = 6.60$, $\underline{p} = .009$). Analysis of the questions individually indicated that the students rated the ISP courses much higher in terms of learning and satisfaction (Questions 2 and 8), but not in terms of difficulty.

The analysis by discipline, however, produced a different pattern of results. Here both the mathematics and physics courses were found to be quite superior to their non-ISP counterparts ($U(3) = 0$, $\underline{p} < .05$). The chemistry courses on the other hand, were consistently rated as less satisfactory than their non-ISP counterparts ($U(3) = 0$, $\underline{p} < .05$). In the multivariate analysis this produced a significant interaction effect between type of course (ISP or non-ISP) and discipline ($\underline{F}(6.18) = 3.56$, $\underline{p} = .017$), with all three questions contributing to this effect. During the first years of ISP the chemistry courses were not generally special ISP courses but in a number of cases (B18-1, B18-2, C40-1) were only extra sections of larger advanced courses. This caused some dissatisfaction among the ISP students and is reflected in their lower ratings on the course evaluations.

While, on the whole, these results are flattering to ISP, it is important to note the limitations on their credibility. ISP courses are all taken by the same group of highly talented students. It is possible that brighter students rate courses differently than their not so talented colleagues taking general science courses. In order to test this, the ratings for a set of freshmen honors or advanced (A) courses in math, chemistry, and physics were examined (see Table 3-1). Once again, the ISP courses are rated more highly than their advanced counterparts (F(3,9) = 4.88, p = .03). As with the general courses, the ISP math courses are consistently superior to their honors counterparts, while the reverse is true for chemistry. The physics courses, while highly rated, are also not rated quite as high as the advanced courses. This again produced a significant interaction effect between type of course and discipline (F(6,16) = 4.81, p = .006) with all three questions contributing equally to the effect.

Since the same students rate all of the ISP courses, our analyses are subject to whatever biases characterize that small group. There is no way of really determining whether the ratings reflect the courses or the idiosyncracies of the group. However, by examining the course ratings of the sophomores during this time, it is possible to get a slightly better picture of the reaction to the ISP curriculum. While this involves only six courses (three math, two physics, and one in chemistry--see Table 3-1 bottom), it does allow the problem of ratings by a single cohort to be overcome. The means for these courses are also presented in Table 3-1 along with data from comparison courses.

Although the pattern of the results are again similar to those found for the courses rated by freshmen, the ISP courses are not statistically superior to non-ISP courses (U(6) = 9, p = .09, one-tailed, F(3,8) = 1.94, p = 20.2). However, this may be due to the small nubmer of observations and thus the inability of the statistics to detect a difference (i.e., low power). The ISP math courses once more are consistently viewed as superior to their general science alternatives. As with the freshmen courses the math courses are the most highly regarded. Interestingly, ISP students rated Chemistry C40-1 more highly than their non-ISP classmates.

Thus, overall ISP courses are quite favorably regarded. They are viewed as superior to the available general science courses and as good as the existing honors courses. In particular, the mathematics courses stand out as the strongest courses while the chemistry courses receive the lowest ratings.

Integration. In order to assess how "integrated" the ISP curriculum was a separate ISP Summary Questionnaire (see Appendix C) was administered at the same time as the CEQ. This questionnaire consisted of 17 items using the same fine-point rating scale (i.e., from '1'--"strongly agree" to '5'--"strongly disagree") as the CEQ. The questions focused specifically on the ISP courses in mathematics, physics, and chemistry. The first six questions dealt with the integration of "material" in these three disciplines; the next six with the coordination or integration of the lectures and demonstrations; the next three with the integration of homework and examinations; and the last two with overall ratings of the program's integration.

The mean ratings for the freshman and sophomore courses offered during 1977-78 are presented in Table 3-2. Students consistently "agree" that ISP as a program has demonstrated "how different scientific disciplines are interrelated" (Question 16) and that the "faculty have successfully created an integrated program" (Question 17). The combined mean ratings are 2.09 and 2.39, respectively. Both ratings are statistically significantly lower than the neutral (i.e., '3') point ($p < .01$).

However, there are considerable differences among the three disciplines in their perceived degree of integration. The pattern that emerges is

Table 3-2

Mean Ratings of Curriculum Integration, 1977-78

Question	Fall		Winter		Spring		Total		
	Soph.	Fresh.	Soph.	Fresh.	Soph.	Fresh.	Soph.	Fresh.	Combined
Material useful:									
1. Math to physics	1.75	1.25	1.79	1.22	2.07	1.30	1.93	1.25	1.52
2. Math to chem.	2.56	3.09	3.80	4.00	2.33	3.77	2.96	3.41	3.24
3. Physics to math.	3.80	2.29	3.46	2.00	3.23	2.29	3.58	2.16	2.69
4. Physics to chem.	3.44	3.96	3.64	3.74	2.36	3.83	3.34	3.69	3.55
5. Chem to math	3.94	4.13	4.13	4.21	3.53	4.08	3.89	4.06	3.99
6. Chem to physics	3.00	4.00	3.86	4.04	2.93	4.08	3.38	3.95	3.73
Teacher Coordination:									
7. Math with physics	2.19	1.30	1.64	1.26	3.36	1.61	2.46	1.36	1.80
8. Math with chem	3.50	3.30	3.93	3.96	3.73	3.87	3.76	3.54	3.63
9. Physics with math	2.25	1.63	2.79	1.33	3.43	1.83	2.76	1.57	2.03
10. Physics with chem	3.31	3.83	4.07	4.09	3.57	4.13	3.71	3.82	3.78
11. Chem with math	3.56	3.83	4.13	4.29	3.40	4.17	3.76	4.01	3.91
12. Chem with physics	3.80	4.00	4.07	4.29	3.29	4.13	3.80	4.05	3.96
Homework Coordinated:									
13. Math with physics	3.44	2.08	2.29	2.13	3.29	2.08	3.13	2.06	2.47
14. Math with chem	3.66	2.33	3.14	3.38	3.43	3.29	3.48	2.92	3.13
15. Physics with chem	3.80	2.33	3.15	3.42	3.38	3.50	3.51	3.02	3.20
Overall, ISP Integration:									
16. Demonstrated	1.81	2.33	2.33	2.00	1.73	2.13	2.04	2.12	2.09
17. Successful	2.20	2.42	2.27	2.38	2.07	2.67	2.35	2.42	2.39

consistent with the one noted for the individual courses in the previous section. Generally, mathematics is seen as the most integrated and chemistry the least. The ratings for the integration of mathematics with physics (Questions 1, 7, and 13) were the most highly rated group of questions (1.52, 1.80, and 2.47, respectively) with all significantly below the neurtral point ($p < .01$). The next most highly rated group of questions concerned the integration of physics with mathematics (Questions 3 and 9). Again, the combined mean ratings of freshmen and sophomores for these questions (2.69 and 2.03, respectively) were significantly below the neutral point. On the other hand, the remaining questions--all involving chemistry--were consistently rated above the neutral point indicating that the students felt this discipline was not well integrated. In particular, those questions (i.e., 5, 6, 11, and 12) asking how well integrated chemistry was with the other disciplines were the lowest rated items. This pattern of results was similar for both freshmen and sophomores.

3.2 The Effect of ISP on Student Grades

While ISP students generally evaluated their courses more favorably than other comparable courses, these ratings might have reflected their grades. Did ISP grades differ from those of other NU students? In order to answer this question, a study was done to determine the effect of ISP on student grades. It was thought, in fact, that ISP students might receive lower grades. Because of their exceptional ability, ISP students probably would be at the top of the grade distribution if they were taking science courses with other students in the university. However, since they are in a special program where they take advanced courses with one another, the distribution of their grades might be changed. For example, students earning C's in ISP courses might get A's and B's in less advanced courses.

In order to determine if the grades of ISP students were adversely affected by their special status, the grades of three groups of students were examined. These included: ISP freshmen, a group of freshmen who were science-oriented (i.e., took at least two science courses per quarter), and a random sample of freshmen chosen from the university at large. All were freshmen in 1976-77. The sample sizes were: 23, 53, and 104, respectively. The ISP students had a cut-off score of 700 on the quantitative portion of the SAT--any student with a score less than 700 was not admitted to the program. The other two groups had subjects with scores both above and below 700.

Two regression-discontinuity analyses were performed, comparing ISP students with non-ISP science students and with the random sample of students. Regression-discontinuity designs can be used in situations where respondents can be classified along a quantified continuum of merit in such a way that persons scoring above a specific cutting point will gain some sort of award and those who score below it will not. If the award has an influence, there will be a discontinuity at the cutting point when regression lines relating the classification variable to an outcome measure are fitted to the groups above and below the cutting point (Cook & Campbell, 1979). Here the classification variable is the college board quantitative score (SAT-M), and the outcome measure is grade point average (GPA). If ISP has an effect on GPA, the intercept of its regression line at the cutting point, its slope, or both should be significantly different from that of a comparison regression line for non-ISP students. If there is a harmful effect, either the slope or intercept would be lower.

It was found that the ISP group had a higher mean SAT quantitative score than either of the other two groups and also a slightly higher mean GPA, though the scores and GPA for all three groups were quite high. The correlation between GPA and SAT scores were relatively low (.08, .38, 41 for the ISP, non-ISP science, and random groups, respectively). The correlation is particularly low for the ISP group because of the truncated distribution of scores.

Neither the slope nor the level of the ISP regression line were statistically different from those of the regression line of the other two groups (see Figs. 3-1 and 2). The slopes of the regression line for the ISP, non-ISP sicence, and random groups are, respectively, .0017, .0028, and .0022. The levels are: 3.1349, 3.1794, and 3.3393. Comparing the ISP group with the non-ISP science group, an $\underline{F}$ of .2691 was obtained $\underline{F}_{crit} = 3.07$). The level of the ISP group does, however, seem to be quite a bit lower than that of the random group, most likely reflecting easier grading in non-science courses. The difference is not statistically significant, probably due to the small size of the ISP group.

Overall, ISP does not appear to have a statistically reliable effect on grades. Thus the ratings of the ISP courses cannot be attributed to grades. If anything, ISP students receive slightly lower grades than their non-ISP science counterparts. This evidently did not influence the evaluation of ISP courses, nor were there noticeable comments on ISP grading policy. Whether the grades ISP students receive will effect their admission to graduate school is beyond the scope of this report and must await a future study.

Reference

Cook, T. D., & Campbell, D. T. Quasi-experimentation: Design and analysis issues for field settings. Chicago: Rand McNally, 1979.

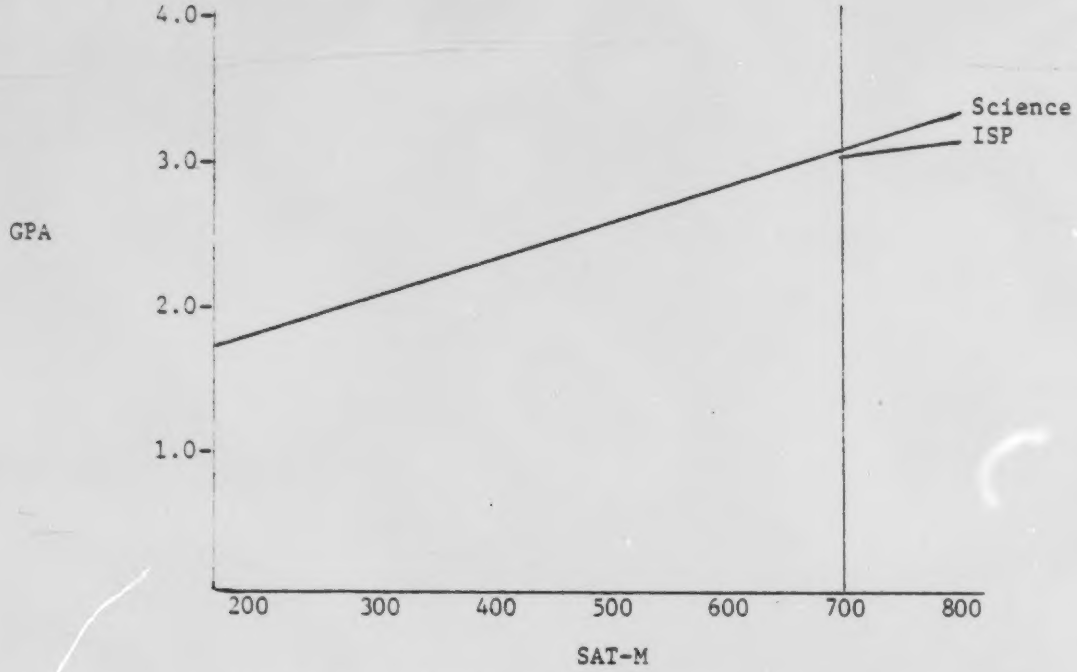

Figure 3-1. Grades of ISP students compared to non-ISP science students.

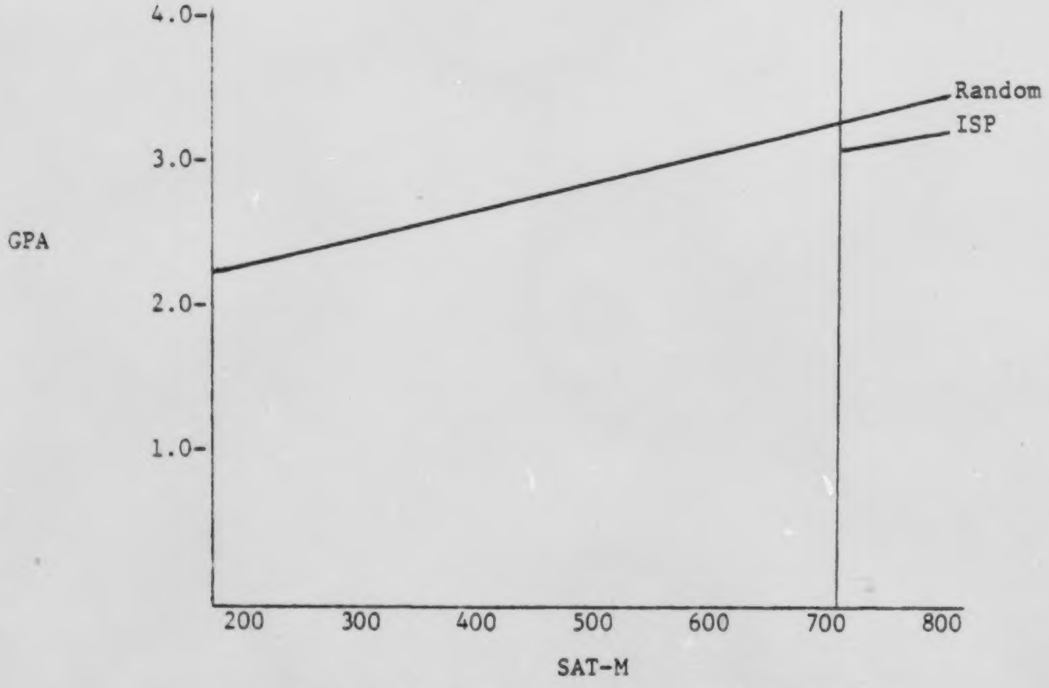

Figure 3-2. Grades of ISP freshmen compared to a random sample of all Northwestern freshmen.

4. STUDENTS

While ISP is primarily an academic program comprised of a sequence of courses, it is important to examine its impact on students using other measures besides grades. To gain a better perspective on the program it is important to describe the students recruited to the program, those who find it unsatisfactory and thus drop out, student attitudes, and student behaviors. The following sections deal with these topics in an attempt to provide a fuller understanding of the program's effect on students. The first section briefly presents the results of the recruitment efforts described in Chapter 2. The next section deals with student activities and attitudes. The last section examines student attrition from the program.

4.1 Recruitment and Admissions

The results of the ISP recruitment efforts described earlier are provided in Table 4-1. For the four years, 1976-79, ISP has averaged 132 applicants, 67 admissions offers, and 32 acceptances. As the table indicates, the size of the entering class has jumped from 30 during the first two years to 34 in the last two classes. This has been done to adjust for those who drop out of the program (see below).

Overall, ISP has been quite successful in recruiting outstanding science students as is indicated by their college board scores (see Table 4-1). The mean SAT scores for ISP students are 656 and 739 for verbal and mathematics aptitude, respectively. These scores have been relatively stable from year to year and are considerably higher than the average scores for all entering Northwestern students (i.e., 581 and 629 for verbal and math tests, respectively). As Figure 4-1 indicates for 1976, they compare quite favorably

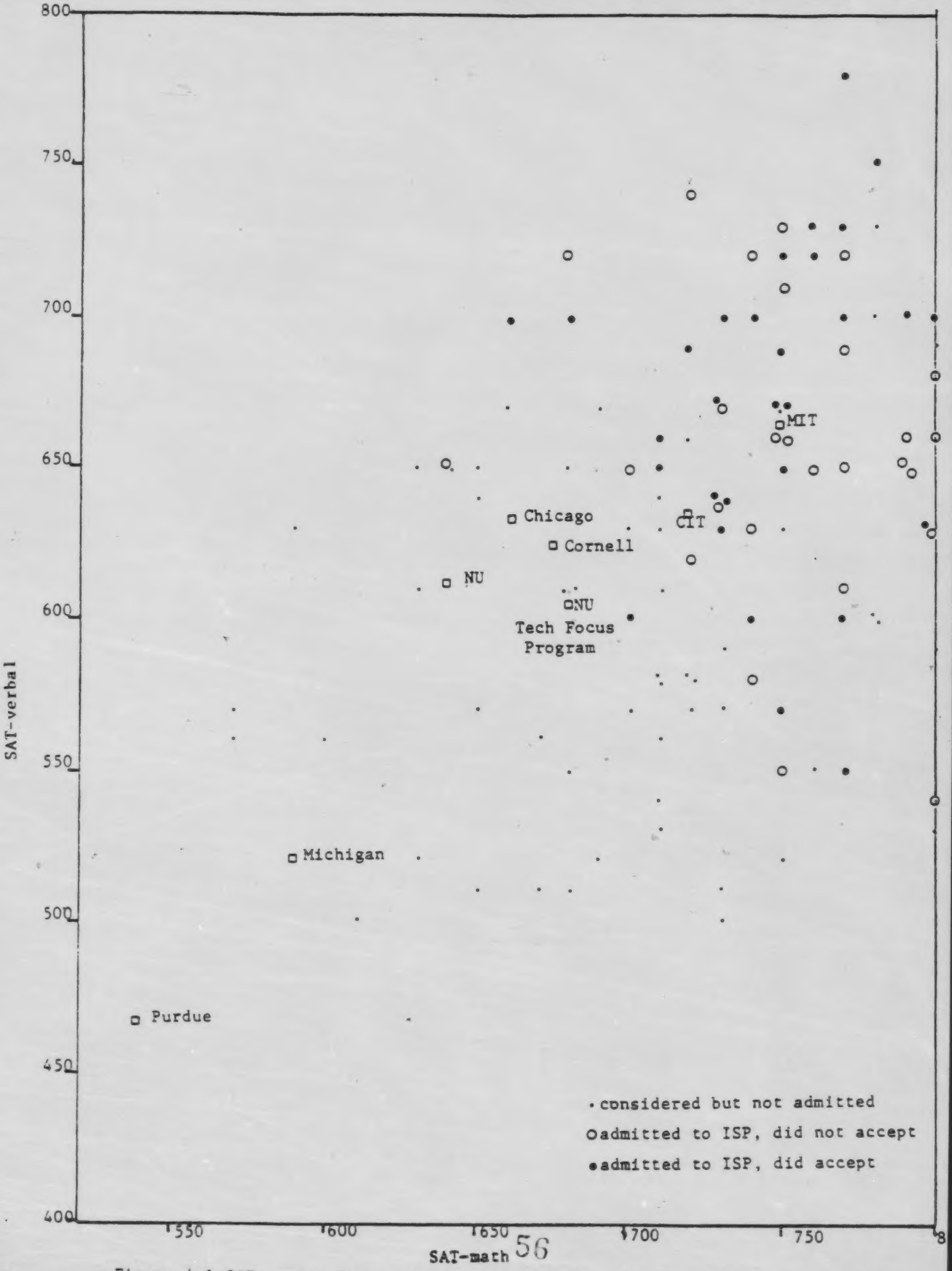

Figure 4-1 SAT scores for admitted ISP students and other universities, 1976.

Table 4-1

Summary of ISP Recruiting Activities

	Year			
Admission Information	1976	1977	1978	1979
Applicants	121	150	128	129
Offers	58	62	81	65
Acceptance	30	30	34	34

Mean SAT Scores[a]	1976	1977	1978	1979
Verbal	663 (583)	681 (580)	641 (580)	640
Mathematics	747 (631)	738 (625)	733 (630)	738
Mathematics Achievement	760	755	753	762

Other Schools Frequently Chosen	1976	1977	1978
Cal Tech	-	2	3
Case Western	1	-	2
Cornell	-	1	3
Harvard	1	4	1
MIT	1	5	6
Princeton	-	1	2
Rensselaer	1	-	2
Stanford	2	1	4

---

[a] Scores for Northwestern in parentheses.

to the nation's premiere scientific institutions, MIT and Cal. Tech. (CIT).

Moreover, as the table indicates, ISP is evidently competing with these and other highly regarded universities. Each year the students who declined offers to enter ISP were asked where they planned to go instead. A large number of them chose to attend more traditional schools with reputations for strong science programs, such as MIT, Stanford, Cal Tech, Harvard, and Cornell. Several chose to enroll in other programs at Northwestern, particularly the Honors Medical Program. Many students chose to attend state universities, perhaps for financial rather than academic reasons. Thus it appears that this program is successfully attracting the high-quality students originally sought.

Location is evidently a factor in attracting students to Northwestern. Each year the majority of the entering class has been from the area bounded by Iowa to the west, Ohio to the East, Minnesota to the north and Indiana to the south. The figures for the three years, 1976-1978, are 70%, 67%, and 68%, respectively; 63% of all entering freshmen at Northwestern in 1978 were from this area. Apparently, Northwestern is predominantly a regional (i.e., Midwestern) school. Within this area it is quite competitive.

4.2 Student Attitudes and Behaviors

An important part of curriculum evaluation is to assess the impact of the program on the students, especially their perceptions of academic life and their allocation of time. The ISP Student Survey was designed to measure these student attitudes and behaviors. The survey was administered to students several times in 1977 and 1978. This section consists of a brief description of the survey form and an examination of students' responses to the questions contained in it.

The Student Survey was based on a questionnaire used in a 1972-1973 study of the attitudes of Northwestern freshmen.[1] Items were modified, added to, and deleted from this questionnaire in order to make it more appropriate for specific use in an assessment of the attitudes and experiences of ISP students. Responses of ISP students and a selected group of non-ISP students to the revised survey form were used to address three key questions:

(1) How do ISP students perceive their program?

(2) How do ISP students change as they progress through the program? and

(3) How do the experiences and feelings of ISP students differ from those of other students at Northwestern?

The answers given to these questions at this point must, for a number of reasons, be considered as tentative. Data were available from only the second and part of the third years of operation of a still-evolving program. The number of students contributing data was, as a result, relatively small. The survey contained over 80 questions, making it fairly likely that some statistically significant findings would emerge just by chance. The data used for different statistical analyses were frequently non-independent. Still, many findings appear to be reasonable, based on theory, prior findings, discussions with students, and rational considerations. Many results emerged in essentially similar form in more than one analysis. While our conclusions may be tentative, they still seem worthy of consideration by those interested in the contribution of ISP to the Northwestern undergraduate curriculum and to the lives of students enrolled in the program.

[1] Wilson, J.R., & Ihlanfeldt, W. I. A report on the freshman year 1972-73 to the committee on educational policies from the Planning Department and the Office of Admission--Revised. Duplicated manuscript. Evanston, Ill.: Northwestern University, March, 1974.

The Student Survey Questionnaire. The ISP Student Survey contained 84 scaled items, plus five open-ended items, divided into 10 separate sections. A complete copy of the survey form is contained in Appendix D.

Section A of the survey consisted of 10 scaled questions concerning the use of various university and community facilities (e.g., the computer and the student union). Each was scored on a five-point scale asking how often the student availed him/herself of these facilities each week (0, 1, 2, 3, 4 or more times).

Section B consisted of 4 questions dealing with student-faculty interaction. Responses on a five-point scale indicated how often students had engaged in each type of interaction during the past school term.

Section C consisted of 5 phrases which might be used to describe ISP instructors, scored on a 7-point scale ranging from "1 - not at all descriptive" to "7 - very descriptive."

Section D contained 13 phrases which could be used to describe the psychological climate of a university program and the attitudes of its students (e.g., "happy," "snobbish"). They were scored on the same 7-point scale as Section C, with responses indicating how well each phrase seemed to characterize ISP.

Section E assessed students' allocation of time (e.g. "what percentage of your waking time is spent in class?") and related issues, using several different response scales, including percentages, raw counts, and rating scales. (This section was slightly revised just prior to the June, 1978 administration.)

Section E of the survey dealt only with whether or not students had been told that they could earn their B.A. in three years and will not be further discussed.

Section G dealt primarily with students' plans for their futures. This topic is discussed more extensively in a later section reporting on interviews held with members of the first ISP graduating class (see Section 5.2) and will only be covered briefly here.

Section H contained 17 items and focused on the contribution of various ISP characteristics and facilities to students' overall satisfaction with the program. The response scale ranged from "1", which indicated that the characteristic made no contribution, to "7", which indicated that its contribution was substantial.

Section I was similar to Section H and assessed students' satisfaction with various aspects of the ISP program. Its 16 questions were answered using a seven-point scale ranging from "1- very dissatisfied" to "7- very satisfied."

Finally, Section J asked students to give overall summaries of their perceptions of ISP. Six objective questions used seven-point scales with various anchors, and a final question asked for suggested changes in ISP.

In revising this questionnaire for use with non-ISP students, the wording of many items was changed by substituting "Northwestern" for "ISP" whenever appropriate, and all questions which did not apply to non-ISP students were deleted. These included all of section H, as well as one or two individual items from several of the other sections.

Subjects and Administration. The Student Survey was administered to all students in ISP in June 1978 at the end of the 1977-78 academic year. Twenty-five freshmen and 19 sophomores filled out the survey form at that time. In addition, the form was filled out by ISP freshmen in Fall 1977 and Fall 1978. These latter administrations enabled us to look at changes occurring during the freshman year and at the comparability of the 1977 and 1978 entering classes. Twenty-nine respondents completed the form in December 1977 and 32 in October 1978. Most students filled out the survey in group testing sessions. Those unable to attend the group sessions were administered the survey individually at their convenience.

In June 1978 a group of non-ISP students were administered a modified version of the ISP Student Survey in order to provide a control baseline to which responses of those enrolled in ISP could be compared. These non-ISP students were carefully selected to meet certain criteria. First, the registrar's files were consulted to select samples of freshman and sophomore students who had entered Northwestern with Scholastic Aptitude Test Quantitative scores of at least 700, a rough cut-off point used in the selection of students for ISP. In addition, each student in the control group had to be enrolled in at least two science courses per quarter. Among the sophomores, this netted a pool of about 60 potential control students; among the freshmen, more than 100 met these criteria. In order to increase the comparability of the freshman sample to ISP students, all students taking less than three science courses per quarter were eliminated. This reduced the available pool of freshman to about 60, comparable to the number of suitable sophomore controls. These 120 students were then contacted by mail, with a follow-up contact made by telephone. The nature of the evaluation project was explained to them, and their cooperation was solicited without further inducement. Twenty-two freshmen and 20 sophomores agreed to cooperate in the assessment procedures, and since those numbers were both roughly comparable to those in the ISP classes and sufficiently large to allow statistical analysis, no further attempts to find control subjects were made. A common testing time was established for the control students, and, as with ISP students, those few who could not attend the group session filled out the survey form on their own.

Preliminary Analysis. Since the large number of items in the student survey and the small number of students responding to it threatened from the outset to lead to problems of interpretation, an attempt was made to "simplify" the data by reducing the number of variables (i.e., questions) of concern. Of the 84 scaled variables contained in the survey, 55 were common to the two forms used for ISP and non-ISP students; the remaining 29 were set aside for later analyses. Of these 55 variables, 40 were scored on seven-point scales of roughly comparable meaning, while the remaining 15 involved various differing response modes. These 15 were also set aside for later analysis. The set of 40 variables remaining, then, naturally fell into three equal groups: those drawn from the D section of the questionnaire (13); those drawn from the I section (14); and the remainder (13), drawn from sections C, J, E, and G.

Each of these three sets of variables was then factor analyzed separately, using the full pool of 44 ISP and 42 non-ISP students responding in June 1978 for each analysis. Factor analysis is a data reduction technique that combines items (or questions) that are highly related (i.e., "load" on a common underlying variable or factor). Two factors appeared sufficient to account for most of the consistent variance in section D, three in section I, and three in the remaining set (CJ). These factors and their defining variables are:

Factor D1, labelled Students, was characterized by high (above .50) factor loadings on descriptions of ISP (or, for the controls, Northwestern) students as happy (D7), not depressed (-D8), friendly (D5), high in group spirit (D6), not snobbish (-D2), and not competitive for grades (-D10).

Factor D2 appeared to be one of academic Standards as set by the students (D13) and faculty (D12).

Factor I1 was concerned primarily with Integratedness of academic subjects, as assessed by the degree of emphasis on interrelationships among sciences and mathematics (I1), on interdisciplinary subjects (I2), and on challenging concepts (I3).

Factor I2 appeared to be an Interaction factor, geared to class size (I5), interaction with students (I9) and with faculty (I11).

Factor I3 was one primarily of academic Freedom, revolving around the perceived amount of freedom in course selection (I7), along with relevance of courses to the students' interests (I8), and a satisfactory work load (I16).

Factor CJ1, Satisfaction, was limited to two variables from the J section: students' satisfaction with (J1) and enjoyment of (J2) their experience with ISP or Northwestern.

Factor CJ2 appeared to be one of Instruction, including three items from the C section which rated instructors as genuinely interested in students (C1), challenging (C4), and open to complaints or suggestions (C5). Students' plans for an advanced degree (G3) also contributed to this factor.

Factor CJ3 appeared as the most subtle factor to emerge in these analyses. The two high-loading variables here were E3c - how useful have you found your interactions with other students in terms of increasing your own comprehension of the material?; and J3 - how would you rate the amount of time required for course assignments? Although no direct relationship between these two variables may appear at first glance, interviews with ISP students and their comments on other portions of the questionnaire suggest that several students in the program have banded together to form study groups of varying sizes. Since such a tendency would appear to underlie the covariation of these two items, this was termed a Group Study factor.

These eight factors thus seemed to summarize most of the information contained in the 40 questions scored on 7-point scales. Consequently, "factor scores" were derived from these factors simply by summing, for each student, the scores on the highest loading variables defining each factor, given above, and dividing by the number of variables summed, to yield scores in the common 7-point range. This procedure, of course, is not as clean as that of using actual (weighted) factor scores, which combine all the variables in ratio to their contribution to any factor. Such "pure" factor scores, on the other hand, are difficult to interpret; while simple scores derived from unit-weighting of the highest loading variables are both far more readily understood and, potentially, more stable in that they do not capitalize as heavily on what may be purely local characteristics of the sample assessed. The following discussion of students' responses will, therefore, involve analysis of students' scores on these eight key factors in addition to analysis of responses to specific survey items.

Students' Perceptions of ISP. Table 4-2 shows mean responses given on the Student Survey by ISP freshmen in December 1977 and June 1978 and by ISP sophomores in June 1978. We will first describe the general view of ISP which seems to be shared by students at all three testing sessions and will then proceed to discuss the changes which seem to take place in students' activities and attitudes as they progress through the program.

Use of University and Community Facilities. A striking aspect of this data is the frequent usage of the ISP lounge in Dearborn. Most students said they entered the lounge during the day about three times per week. Evening use, though somewhat less prevalent, also appears to be common. While students sometimes enter the lounge only to check their mailboxes, they also seem to use it as a place to wait between classes, a place to study, and a place to meet with their fellow ISP students.

Not surprisingly, for motivated students in a difficult academic program, participation in recreational and cultural activities appears to be rather rare. Utilization of campus athletic facilities and attendance at theatrical and musical productions, movies, and non-class lectures among freshmen, all average less than once a week, and sophomores differ only in their increased usage of the university gymnasiums.

Interactions with Faculty Members. Students reported meeting with instructors a little more than once per term to discuss their progress in specific courses and less often than that to discuss their overall progress and goals. Students seem to have surprisingly few interactions with their academic advisors. Freshmen filling out the survey in fall 1977 reported meeting with advisors an average of only .89 times during the fall quarter. About one-fifth of the class never met with an advisor during their first term on campus.

Table 4-2

Mean Student Survey responses of Fall quarter freshmen, Spring quarter freshmen, and Spring quarter sophomores[a]

		Fresh. Fall 77 (n=28)		Fresh. Spr. 78 (n=25)		Soph. Spr. 78 (n=19)
A.	USAGE					
1.	Library	1.86		1.88		2.11
2.	Norris Center	1.39		1.08	*	1.84
3.	Gyms	.54		.76	*	1.89
4.	Cultural Event	.50		.44		.42
5.	Movie	.46		.60		.74
6.	Speech	.25		.20		.26
7.	Computing Center	.29		.40		.63
8.	ISP Terminal	1.79	**	.92		1.63
9.	ISP Lounge-day	3.57		3.28		2.53
10.	ISP Lounge-night	2.57		2.20		1.84
B.	FACULTY INTERACTION					
1.	Discuss Course	1.14		1.20		1.26
2.	Discuss Goals	.21		.56		.74
3.	Meet Advisor	.89		1.04		.74
4.	Receive Positive Feedback	.27		.67		.63
C.	INSTRUCTORS					
1.	Interested in Students	6.00		5.88	*	5.05
2.	Not Know Student Name	1.61	*	2.32		2.68
3.	Grading Irrelevant	2.07		2.56		2.53
4.	Challenging	6.18	*	5.56	*	4.63
5.	Open to Complaints	5.39		5.32		5.21
D.	CLIMATE					
1.	Intellectual	5.68		5.32		5.63
2.	Snobbish	2.39		2.96		2.89
3.	Social	4.43		4.12		3.37
4.	Practical-minded	4.89		4.56		4.47
5.	Friendly	5.68		5.20		4.42
6.	Group-spirit	5.43	*	4.50		3.84
7.	Happy	4.71		4.25		4.26
8.	Depressed	3.46		3.63		3.47
9.	Affection for N.U.	3.71	*	3.04		3.26
10.	Competitive	3.75		4.08		4.53
11.	Honesty & Integrity	5.71		5.54		5.72
12.	High faculty Standards	6.14		5.92		5.58
13.	High Student Standards	5.64		5.71		5.53

Table 4-2 Cont'd.

		Fresh. Fall 77		Fresh. Spr. 78		Soph. Spr. 78
E.	TIME					
1.	% in class	not asked		25		22
2.	% Academic Outside Class	not asked		33		31
3a.	#top 3 Academic in ISP	2.50		2.20		2.00
3b.	% Academic with ISP	60	*	35		32
3c.	Student Interactions Useful	not asked		5.64		5.16
4a.	#top 3 non-academic	1.48		1.12		.84
4b.	% non-academic with ISP	33		24		20
G.	FUTURE					
1.	Want ISP 4 years	3.46		4.20		3.44
2.	4th Year at N.U.	5.57		5.55		5.94
3.	Advanced Degree	6.61	*	6.00		6.47
6.	Future in Science	6.04		5.90		5.93
H.	IMPORTANCE					
1.	ISP Lounge	5.18	*	4.84		4.21
2.	ISP Seminars	4.11		4.24		3.68
3.	Lab Visits	3.83		3.70	*	2.59
4.	Computer Facilities	5.43	*	4.92		4.53
5.	Computer Instruction	4.46		4.48	*	2.84
6.	Intelligent Students	5.54		5.32		4.79
7.	Students Liking Science	5.54		5.32		4.58
8.	Degree in 3 Years	4.48		4.24		4.47
9.	Two Degrees in 4 Years	5.21		4.76		4.78
10.	No Major	5.18		4.60		4.26
11.	Covers all Science & Math	6.07		5.84		5.63
12.	Integrative	6.00		5.71		5.11
13.	Accelerated	6.07		5.96		5.53
14.	Small Class Size	6.36	*	6.12		5.47
15.	Good Faculty	6.32	*	5.92		5.39
16.	Advising System	4.48	*	3.38		2.79
17.	Appeal to Grad. Students	5.26	*	4.52		4.32

Table 4-2 Cont'd.

	Fresh. Fall 77		Fresh. Spr. 78		Soph. Spr. 78
I. SATISFACTION					
1. Math & Science Integration	5.25		5.20		5.26
2. Interdisciplinary	4.89		4.48		4.68
3. Challenging	5.44		5.52		5.37
4. Mastery of Basics	4.68		4.88		4.42
5. Class Size	6.57	*	6.12		5.95
6. Difficulty	5.61		5.68		5.58
7. Freedom	3.21	*	2.52		2.95
8. Relevance	5.04		4.56		4.00
9. Interact with ISP Students	5.64		5.20		4.84
10. Interact with Other Students	4.36		3.80		4.26
11. Interact with ISP Faculty	5.18		4.80		5.11
12. Interact with other Faculty	3.67		3.68		3.84
13. Faculty Guidance	4.25		3.76		3.53
14. Physical Facilities	5.82	*	5.36		5.11
15. Creative Outlets	3.96		3.60		3.95
16. Workload	4.21		3.96		3.95
J. GENERAL					
1. Satisfaction	5.37	*	4.84		4.63
2. Enjoyment	5.41		5.28		4.68
3. Time Required	5.04		5.16		5.00
4. Knowledge Gained vs. Wanted	not asked		4.96		4.32
5. Hard to manage time	4.71		4.96	*	3.95
6. ISP better than Traditional	5.92		5.63		5.83

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*Means differ at $p < .05$ level.

**Means differ at $p < .01$ level

[a] Probability levels for changes in freshman year are based on a repeated-measures analysis for students present at both testings; group means in this table are based on all available responses.

Several students commented on the perceived inadequacies of the ISP advising system either in Section B of the questionnaire or at the end, where suggestions for improvements in the program were solicited. For example, some commented that ISP would be improved if students had greater contact with their academic advisors. One student wrote: "I haven't gotten any advice! Goodness knows I need it too!" Another commented that those doing poorly in their courses were especially in need of greater counseling. At least some respondents at all testing sessions seemed to feel a need for greater guidance and support from the ISP staff.

Evaluations of Instructors. Overall, students seemed quite pleased with their course instructors. Students felt that the instructors were interested in them and also that they created stimulating class environments. They perceived faculty members as generally open to complaints and suggestions from students and as fair in their assignment of course grades.

Psychological Climate. ISP students rated 13 phrases with respect to how well they described the atmosphere within ISP and/or the attitudes of ISP students. Fall quarter freshmen, spring quarter freshmen, and spring quarter sophomores all thought the phrases most characteristic of their program and their fellow students were:

1) high academic standards set by the faculty;
2) high level of academic honesty and integrity;
3) high academic standards set by the students for themselves; and
4) intellectual.

Thus the superior academic quality of the program appears to be the outstanding feature of it.

Phrases judged least characteristic of ISP were:

1) snobbish;

2) depressed;

3) genuine affection for the school; and

4) social.

It is interesting that while students seem generally pleased with their ISP experience, they apparently do not have especially warm feelings about the university as a whole.

Allocation of Time. Students report spending about a quarter of their working time in class and about a third in academic activities outside of the classroom. Fall quarter freshmen spent 60% of their academic time outside of class with fellow ISP students, but this figure drops by nearly half for those further along in the program, who have had more time to meet students through other channels. Still, students report that when they do work with classmates on course assignments, these interactions are often quite useful.

Students also report spending about one-quarter of their non-academic time with others in ISP. It might be noted here that ISP students have organized their own sports teams (complete with special ISP T-shirts) and planned group parties. Combining data on academic and non-academic time, it would appear that the average ISP student spends more than one-fourth of his or her non-class waking time in the company of other ISP students, or almost one-half of his or her total waking time with others in ISP. While no other statistics are available to which these values can be compared, they would appear to indicate a substantial amount of group cohesiveness.

In order to obtain more detailed data on what ISP students did during a typical day, all ISP students were sent memos early in 1978 asking if they were willing to fill out a diary form indicating what they were doing every half hour during a particular 24-hour period. A group of six students (four freshmen and two sophomores) subsequently filled out such forms for randomly chosen weekdays in the middle of the 1978 Spring term. The small size of this sample, along with the absence of a comparison group, preclude the drawing of any firm conclusions from these students' responses. Still, an inspection of their responses does provide an interesting view of what an average day in the life of an ISP student might be like.

The diary form asked students to record for each half hour time period which of three categories best described the activity in which they were engaged. The three categories were:

(1) Maintenance activities: eating, sleeping, etc.
(2) Recreational activities: TV, participating in sports, chatting with friends, etc.
(3) Academic activities: homework, or discussing course material.

For time spent in academic activities, students were to indicate whether the time was spent in class or outside of the classroom and whether ISP or non-ISP courses were involved. Students gave additional details about their activities in the "comments" space provided for each 30-minute time period.

Overall, students reported spending an average of 41% of their time in maintenance activities. Three-fourths of this maintenance time was spent in sleeping. Students spent an average of 7 1/2 hours asleep, with none of the six respondents sleeping less than six or more than eight hours. On the particular days for which diary forms were filled out, then, it would seem that most students got an adequate amount of sleep.

All students reported spending part of their day in recreational activities, but the exact amount of time varied greatly from student to student, ranging from a low of 30 minutes to a high of 6 1/2 hours. On the average, 11% of the day, or about 2 3/4 hours, was devoted to recreation. Students' detailed comments indicated that the most popular recreational activity, accounting for more than one-third of students' recreational time, was talking with other people. Other activities included reading newspapers or novels, writing letters, watching TV, or engaging in such athletic pursuits as softball, swimming, and jogging. Thus while responses to the ISP Student Survey suggest that some ISP students feel overworked, the sample filling out our diary form did manage to fit some "play" activities into their day. (It seems reasonable, however, that those students who feel they have the least time to spare for non-school-related activities would be least likely to volunteer to spend time filling out our diary form.)

Three students reported that they spent part of their day on an activity which fit into none of our three categories. Two of the six respondents spent some time working at jobs, and a third spent part of the afternoon looking for a job for the summer. Thus, half the respondents spent some time in job activities, and the average amount of time spent by these three students was 1 2/3 hours.

Not surprisingly for a group of highly motivated college students, academic activities accounted for the greatest proportion of their time. Students spent an average of 10 1/2 hours on academic pursuits. This is about 44% of the total 24-hour day and 64% of the time during which students were not sleeping. There was little variability in the amount of time students spent working on their courses. Five out of the six students spent between 10 and 12 1/2 hours in this way. (The exception was a sophomore who spent little time on homework and quite a bit on recreational activities.)

Students were asked to classify their academic activities according to whether they took place inside or out of the classroom. Students spent an average of 4 1/4 hours, or 18% of the day, in classrooms, and most of this--an average of about 3 1/2 hours--was spent in ISP classes. They spent an average of about 6 1/4 hours, or 26% of the day, doing homework. Again, most of this time (more than 5 hours) was devoted to ISP courses.

For time spent doing homework, students were asked to report whether they were working alone or with other students. Whether the work was related to ISP or non-ISP courses, students generally worked alone. When students were doing ISP work, they worked alone about 80% of the time, and half of the respondents never worked with others. When students did work with other people, these others were almost always ISP students. In fact, the one time an assignment for a non-ISP course was worked on with another student, this student was also a member of the ISP group. The fact that when students are not working alone, they are almost always working with other ISP students fits well with certain findings derived from the Student Survey.

In summary, then, the six students who filled out diary forms spent an average of about 7 1/2 hours of the day sleeping, 2 1/4 hours in other maintenance activities, 2 3/4 hours in recreational activities, 45 minutes on job activities, and 10 1/2 hours on academic activities. An average of about 8 1/2 hours, or a bit more than a full traditional 8-hour work day, was spent on activities directly related to ISP courses.

Importance of and Satisfaction With Various Aspects of the Program. Students rated 17 aspects of ISP with respect to how much they contributed towards making ISP a satisfying educational experience. They also indicated their level of satisfaction with 16 aspects of the program. Those aspects seen as contributing most to overall satisfaction were:

1) small class size;
2) accelerated and rigorous courses;
3) curriculum encompassing all the natural sciences and math; and
4) use of N.U.'s best faculty.

Those seen as contributing least were:

1) lab visits;
2) ISP seminars;
3) ISP advising system; and
4) computer instruction.

These first two characteristics are probably unimportant because they are such minor aspects of the program. Indeed, some students commented that they were unaware of the existence of lab visits. The low ratings given to the advisory system and computer instruction probably stem from dissatisfaction with these aspects of the program (see next section).

The list of program characteristics with which students were asked to indicate their satisfaction was similar, though not identical, to that for which they gave ratings of importance. Few characteristics ever received ratings indicating that students were more dissatisfied than satisfied with them. However, students did appear dissatisfied with:

1) quality of advice and guidance received from faculty;
2) degree of freedom in course selection;
3) number of outlets for creative activities; and
4) amount of interaction with non-ISP faculty.

Responses in this section too, then, show that the advising system within ISP was judged to be inadequate.

The last three items in the above list may all be seen as indicating that ISP students feel too restricted with respect to what courses they can take. This dissatisfaction was also evident in students' suggestions for improvements in ISP. The most common type of suggestion had to do with the desire for greater flexibility. Two different kinds of suggestions fit into this category. First, students sought more electives outside ISP. Several commented that the program was fine for students who only wanted to study science, but too restrictive for those with broader interests. Students also noted that they were prevented from taking certain attractive non-ISP courses because so many of the time slots in their schedules had to be reserved for ISP courses.

The other group of suggestions related to flexibility had to do with flexibility within the ISP curriculum. While students seemed pleased with the basic four-quarter core sequence, some thought the more specialized courses should not be required of all students. Some ISP students seem especially interested in the physical sciences, while others are more oriented towards the life sciences. Many of these students would like to see separate life and physical science tracks within ISP after the first few quarters, or perhaps a set of upper-level courses from which students are required to choose a fixed number. As one student noted, people often don't want to take courses they think they'll never use, and this is especially so if they feel that taking these courses prevents them from taking other courses that they do want.

While ISP students are unhappy with a few aspects of their program, they reported quite high levles of satisfaction with others. Those aspects with which they reported being most satisfied were:

1) size of ISP classes;
2) difficulty level of ISP courses;
3) degree of exposure to new and challenging concepts; and
4) physical facilities of the ISP program.

We have already noted that students see the academic rigor of their program as a salient aspect and an important one. They also seem satisfied with that aspect.

First-term freshmen and freshmen and sophomores responding in the spring all agreed on what aspect of ISP was most satisfying: the size of ISP classes. Since most classes taken by ISP students contain only other ISP students in their year, their maximum class size is about 30. In contrast, the earlier report on Northwestern freshmen[1] noted that in 1972 44% of the A and B level courses (those at the introductory and intermediate levels) in the College of Arts and Sciences contained over 100 students. Thus, class sizes within ISP are clearly relatively small, and students clearly find small class sizes highly desirable.

Overall Feelings. The final section in the Student Survey included general questions about the amount of time required for ISP course assignments, the desirability of ISP relative to other science programs at N.U., and about overall satisfaction with the program. Students seemed to feel that course assignments took a bit too much of their time, and a few commented either that they felt overworked or that they wished they had more time for non-academic activities. Feelings of overwork, along with unhappiness with the lack of sufficient freedom and sufficient guidance seem to cause ISP students to be moderately, instead of extremely, satisfied with the ISP program as a whole. Finally, ISP students seem to feel that their program compares quite favorably with other Northwestern science programs. Some students seemed to feel less than enthusiastic about being at N.U., but many seemed to feel that, given that they were enrolled at this school, they were glad that they were also enrolled in its Integrated Science Program.

Changes over Time

Table 4-2 includes information about the consistency of students' responses from the first term to the third term of their freshman year and from the third term of their freshman year to the third term of their sophomore one. The first set of comparisons was made primarily by calculating the value of the *t* statistic for correlated samples using responses of freshman students present at both the fall 1977 and the spring 1978 testings. (Note that the means in Table 4-2 are based on responses of all students who filled out the survey form, not just on those of students present in both fall and spring. In general, however, deletion of those absent from one testing session has little effect on the means.) Since the spring-freshman and spring-sophomore data came from different samples of students, ordinary *t*-tests were carried out on these data.

Responses of fall quarter and spring quarter freshmen differed in several respects. Spring responses indicated less usage of computer facilities, probably because formal computer instruction occurred in the fall. They also indicate less positive attitudes towards professors, who are seen as less likely to know students' names and less likely to challenge them to do their best. Spring responses reflect a decrease in affection for the university, a decrease also apparent in the responses of freshman studied for the earlier report on Northwestern students' attitudes[1], as well as a decrease in group spirit. Ratings of how well the phrase "lots of group spirit" seems to characterize ISP continue to drop, though not significantly, from spring of the freshman year to spring of the sophomore one, going from above to below the midpoint of the rating scale. This decrease in group spirit is accompanied by a decrease in the proportion of academic-related time spent with fellow ISP students.

As compared to fall quarter freshman, spring quarter freshmen are less sure, on the average, that they will get an advanced degree. Still, most student at both testing sessions felt very certain that a graduate degree was something they hoped to obtain. Spring term freshmen rated several aspects of ISP as contributing less to their overall satisfaction with the program. They reported declines in satisfaction with class size, freedom of course selection, and physical facilities, as well as in overall satisfaction. However, satisfaction with class size was extremely high at both points in time, while satisfaction with freedom in course selection was always quite low.

In contrast to the sizeable number of changes in attitude occurring during the freshman year, responses of spring-term freshmen and spring-term sophomores to the Student Survey hardly differed at all. As can be seen in Table 4-4, to be discussed more fully below, they differed on only one of the eight basic factors summarizing the data, factor CJ2, with sophomore respondents reporting less favorable attitudes towards their instructors. In addition, sophomores use the student center and university gyms more and value lab visits and computer instruction less. Not surprisingly, as a result of their increased experience, they also find it easier to manage their time.

In addition to comparing mean ratings on individual items for the three sets of responses, we also computed rank-order correlations to see if feelings about which phrases best characterized the program (Section D), which aspects of the program were most important (Section H), and which aspects were most satisfying (Section I) differed from one group to another. All rank-order correlations comparing freshmen's responses in fall and spring and comparing spring quarter freshmen and spring quarter sophomores were quite high, with values ranging from .85 to .99. Thus, while changes did occur on individual items in these sections, there were no overall changes in their relative ranks.

One additional source of information on how students' feelings about ISP changed as they progressed through it is the suggestions for improvement that were offered by students at the different testing sessions. Fall and spring quarter freshmen differed little in this respect. However, freshmen, but not sophomores, offered criticisms of their chemistry and computer courses, while sophomores never complained about specific courses or instructors. As noted in Chapter 3, this reflects specific problems with chemistry and computer instruction in the freshman year. Further data relevant to this point is contained in the next Section of this report dealing with student attrition.

Several freshmen, but no sophomores, noted that they would prefer to see a greater homogeneity of background among ISP students. For instance, one respondent thought students should be assigned to different tracks, commensurate with their backgrounds, and another thought entering freshmen should be sent preparatory study materials during the summer before they arrived on campus. By the end of the sophomore year, after ISP students had gone through 18 courses together, differences in background were no longer an issue.

One type of criticism of the ISP curriculum was more characteristic of sophomores than of freshmen. Apparently several sophomores had decided that they wanted to pursue careers in biology or medicine. Thus they suggested that the curriculum include more biology or require less physics and that the faculty recognize the fact that some students sought to use ISP as a stepping-stone to medical school. While the staff have not generally viewed ISP as a pre-med program, a number of these students indicated that they intended to work not as practicing clinicians, but as medical researchers. Training medical researchers with strong scientific backgrounds may be compatible with the general aims of ISP, and the staff should consider accommodating these students' needs rather than, to quote one student, have them "quit ISP to get some bio for MCATS."

Before closing this section, it is necessary to comment on the results of an analysis comparing responses of freshmen students to the Student Survey in December 1977 and October 1978. These two groups of students gave significantly different responses on many survey items. Despite the fact that those responding in 1978 had been on campus about six weeks less than those responding in fall 1977, their responses often resembled those of spring-quarter freshmen and/or spring-quarter sophomores more than those of the fall 1977 freshmen. Because of this difference among cohorts, all conclusions about changes in ISP students as they progress through the program must be viewed as especially tentative.

Differences Between ISP and Non-ISP Students.

In attempting to interpret differences between ISP and non-ISP students, it should be recalled that the non-ISP control students selected for these comparisons are not intended to be a set of "representative" Northwestern students, but rather a group of intellectually superior students, sharing with those of ISP both high entrance examination scores and an emphasis on science courses.

Table 4-3 shows mean June 1978 responses of ISP and non-ISP students to all questionnaire items given to both sets of students and indicates where responses of the two groups significantly differed. Table 4-4 presents the summary statistics comparing ISP with non-ISP students, and freshmen with sophomores, for the eight "factors" generated from those items of the Student Survey that allowed responses to be made on seven-point scales. (Missing values, as they occurred in the raw data, were corrected by substituting the value of 4.00 - absolute neutrality - in each such case; since the means of most variables lay well away from this value, however, this may be considered a conservative correction.) The latter table reports mean factor scores for the 25 ISP freshmen, 19 ISP sophomores, 22 non-ISP freshmen, and 20 non-ISP sophomores respondong in June 1978. The means for these four groups are shown in the first two columns of Table 4-4, with those for freshmen in the upper row, sophomores in the lower, ISP on the left, non-ISP on the right. In analyzing factor scores, an initial "omnibus" _F_, testing the mean-square between groups against the mean-square within groups was used to indicate whether there were any meaningful differences among the four groups of students. This statistic is reported in the upper row of column three of Table 4-4; where it proved _non_-significant, no further analyses were undertaken.

Given a significant omnibus _F_, a straightforward 2 x 2 unweighted means analysis of variance was undertaken, comparing ISP with non-ISP students, freshmen with sophomores, and assessing the interaction. Of the five factors showing significant omnibus _F_ values, the subsequent _F_'s showed highly

Table 4-3

Mean Student Survey responses of ISP and
non-ISP student, Spring 1978.

Item	ISP (n=44)		Control (n=42)
A. USAGE			
1. Library	1.98		2.38
2. Norris Center	1.41		1.57
3. Gyms	1.25		1.29
4. Cultural Event	.43		.53
5. Movie	.66		.83
6. Speech	.23		.40
7. Computing Center	.50		.48
8. Other computer	1.73	*	.52
B. FACULTY INTERACTION			
1. Discuss course	1.23		1.50
2. Discuss goals	.64		.71
3. Meet advisor	.91		1.00
4. Receive positive feedback	.65		.76
C. INSTRUCTORS			
1. Interested in students	5.52	*	4.66
2. Not know students' names	2.48	**	4.34
3. Grading irrelevant	2.55		2.27
4. Challenging	5.16	*	4.32
5. Open to complaints	5.27	**	4.10
D. CLIMATE			
1. Intellectual	5.45		5.71
2. Snobbish	2.93	**	4.37
3. Social	3.80		3.83
4. Practical-minded	4.52		4.44
5. Friendly	4.86		4.12
6. Group spirit	4.21	**	2.88
7. Happy	4.26		3.90
8. Depressed	3.56		3.88
9. Affection for N.U.	3.14		3.24
10. Competitive	4.27	**	5.93
11. Honesty and integrity	5.62	**	4.46
12. High faculty standards	5.77		5.51
13. High Student standards	5.63		5.59
E. TIME			
1. % in class	23		22
2. % academic outside class	32		30
3. Student interactions useful	5.43	**	3.76

Table 4-3 Cont'd.

Item	ISP		Control
G. FUTURE			
3. Advanced degree	6.19	*	5.29
6. Career in science	5.91		5.90
I. SATISFACTION			
1. Math and science integration	5.22		4.69
2. Interdisciplinary	4.57		4.05
3. Challenging	5.46	*	4.88
4. Mastery of basics	4.68		4.44
5. Class size	6.05	**	4.71
6. Difficulty	5.64	*	5.14
7. Freedom	2.70	**	4.95
8. Relevance	4.32	*	5.05
9. Interact with (ISP) students	5.05	*	4.26
11. Interact with (ISP faculty	4.93	**	3.52
13. Faculty guidance	3.66		3.70
14. Physical facilities	5.25	**	4.19
15. Creative Outlets	3.75		3.41
16. Work load	3.95		4.81
J. GENERAL			
1. Satisfaction	4.75		5.17
2. Enjoyment	5.02		5.12
3. Time required	5.09	**	4.40
4. Knowledge gained vs wanted	4.68		4.41
5. Hard to manage time	4.52	*	3.69

*Means differ at .05 level

**Means differ at .01 level

Table 4-4

Mean factor scores for ISP and non-ISP freshmen and sophomores, Spring 1978.

Factor	Means		Value of Omnibus *F*	Significance Levels				
	ISP	Control		Fresh	Soph		ISP	Control
	Fresh (N=25) Soph (N=19)	Fresh (N=22) Soph (N=20)		ISP-C	ISP-C	ISP-C	F-S	F-S
D1	4.54	3.67	9.04*	.01	.01	.01	—	.05
Students	4.26	3.25						
D2	5.74	5.32	1.20					
Standards	5.55	5.72						
I1	5.07	4.70	2.34					
Integration	5.11	4.37						
I2	5.37	3.89	9.72*	.01	.01	.01	--	.01
Interaction	5.30	4.47						
I3	3.68	5.30	10.61*	.01	.01	.01	--	.01
Freedom	3.63	4.53						
CJ1	5.06	5.20	.78					
Satisfaction	4.66	5.05						
CJ2	5.61	4.77	6.73*	.01	.01	.01	.05	.05
Instruction	5.21	4.38						
CJ3	5.40	3.82	9.69*	.01	.01	.01	--	.01
Group Study	5.08	4.38						

*Significant beyond the .01 level.

significant differences between ISP and non-ISP students in all cases: these values are given in the fourth column of the Table. None of these five analyses showed significant freshman-sophomore differences, and only one (CJ3) revealed a significant interaction (F = 8.75).

Tukey's HSD test was selected as the most appropriate multiple-range *t*-test to compare differences within the four groups. It should be noted that this test allows all comparisons to be made among a given set of means; since in the present case only four comparisons of the six that could be made were of interest, this test too is slightly conservative for the present purposes. The resulting significance levels for the various comparisons (Freshman: ISP vs. non-ISP; Sophomore: ISP vs. non-ISP; ISP: freshmen vs. sophomores; non-ISP: freshman vs. sophomores) are given in the final four columns of Table 4-4.

At present, only the differences between ISP and non-ISP students are of concern, and these may be summarized in terms of several observations:

1) ISP students show large differences from non-ISP students on factors assessing their fellow students (Factor D1), interaction among students and faculty (Factor I2), freedom of the curriculum (Factor I3), quality of instruction (Factor CJ2), and tendency to form study groups (Factor CJ3). They do not differ from non-ISP students with regard to academic standards (Factor D2), perceived integratedness of their programs (Factor I1), and general satisfaction (Factor CJ1).

2) In all cases where there is a significant overall difference between ISP and non-ISP students, these differences characterize both freshmen and sophomores equally.

3) In all four of the five cases, ISP students regard their program more favorably than non-ISP students regard theirs. The only exception comes in

the case of the factor assessing primarily freedom of course selection, where ISP students (quite accurately) perceive themselves as more constrained than do non-ISP students.

4) In addition to the differences tapped by the variables included in these factors, Table 4-3 indicates that ISP students, as compared to non-ISP students, feel that instructors get to know them by name more (C2), and are more impressed by fellow students' honesty and integrity (D11) and by the physical facilities offered by ISP (I14 - as compared to Northwestern in general for the controls). Less significant differences (which meet the .05 criterion only on the risky assumption of independent tests) indicate that ISP students make more use of their own computer than non-ISP students make use of non-central-computer facilities (A8) and regard their program as more difficult than non-ISP students regard the general sciences program (I16).

Changes Over Time. Table 4-4 presents most of the key data regarding changes in students' factor scores as they progress through their freshman and sophomore years. As noted above, simple F ratios indicated that no overall differences between freshmen and sophomores could be found on any of these factors, and that only one interaction (CJ3) proved significant. The Tukey tests, however, present a somewhat more detailed picture.

As indicated in Table 4-4, all tests comparing non-ISP freshmen with sophomores proved significant, while only one of the parallel comparisons within ISP showed a significant value. The patterns of freshman-sophomore differences in the non-ISP students appears quite characteristic of the typical tendency toward a more jaded and cynical attitude toward the university, often described as the "sophomore slump." Non-ISP sophomores tend to think less well of their fellows (D1), perceive themselves as more contrained (I3) and think less well of the quality of their instruction (CJ2) than do freshmen. The two factors on which sophomores outscore freshmen, on the other hand, may be attributed largely to the fact that they have been in the university longer, and thus have had more opportunities for interaction with others (I2), and to form group study cells (CJ3).

Parallel differences to these, within ISP, can be found only for the factor assessing the quality of instruction. Thus, it appears that whatever enthusiasm characterizes entering freshmen at Northwestern is largely maintained if they are in ISP, but often lost if they are in the general sciences program. However, it should be noted that absence of a "sophomore slump" may reflect only that those dissatisfied with ISP have left the program.

Discussion of Student Survey Responses.

Students' perceptions. As indicated in the results above, the students in ISP perceive their program quite favorably; so favorably, in fact that it is immediately tempting to speculate about the possibility of a "Hawthorne effect" in these data (i.e., any change will produce a favorable outcome). Although it is, of course, impossible to rule this out entirely, at least two considerations suggest that it may not be very significant.

First, it should be noted that Hawthorne effects primarily disturb researchers and statisticians, by contaminating the purity of their measures. Program designers and administrators, in contrast, may well see such effects as quite desirable. Thus, in the present case, tendencies for students in ISP to see themselves as a special group, different from other Northwestern students by virtue of a better program, and to develop feelings of group cohesiveness expressed in above-average esteem for and degree of interaction with each other would appear to be thoroughly desirable from the standpoint of the program's goals, regardless of their source.

Second, however, several of the individual means for survey items suggest that, at a minimum, if a Hawthorne effect is at work here, it is not working in such a fashion as to impair the finer discriminatory abilities of the students. Not all their judgments are positive, and one in particular (D6 - group spirit) is merely neutral where one would expect it to be most susceptible to Hawthorne-type inflation. Similarly, while instructors are viewed as persons who are genuinely interested in students (C1), get to know them by name (C2), and interact satisfactorily with them (I11), they do not, apparently, supply sufficient guidance (H16 and I13). While these examples are not sufficient to fully discount Hawthorne-type explanations for these findings, they do appear sufficient to minimize their impact.

Against this pattern of overall satisfaction with the program, then, the two aspects of it that emerge as most consistently negatively evaluated by ISP students are the lack of freedom in course selection and the lack of sufficient guidance from the faculty. Neither of these criticisms appears very severe (but see next section on attrition), either in terms of its actual magnitude or in terms of its larger significance. The lack of freedom presented by the program appears to be a more intractable problem since any attempt to relax this structure risks eliminating key aspects of the program. Nevertheless, it appears that some students who want the rigorous and integrated science education offered by ISP and who hope someday to be the "panscientists" ISP seeks to train would find ISP even more appealing if it offered greater flexibility in choice of courses. For example, more non-science electives could be provided by making ISP a four-year program, and/or allowing students to choose among certain upper-level science courses. This would decrease the frustration some ISP students seem to feel, and it might also make ISP attractive to a wider range of potential students.

The relative lack of guidance perceived by ISP students similarly may be due in part to the facts that: a) the program is sufficiently structured that little more guidance can be offered on this level and b) the program is sufficiently new that little guidance, in terms of longer range events such as graduate placement or occupational choices, can presently be offered. On the other hand, interviews with students suggest that it is not uncommon to find students interested primarily in medicine or other biological fields entering ISP, while the program itself is perceived as geared more directly to the "harder" sciences (Physics, Maths, Chemistry, Geophysics). It may thus prove useful for program administrators to attempt to communicate the goals and purposes of ISP in a clearer fashion to potential students prior to their admission into ISP.

Furthermore, the freshman year in ISP would appear to be an especially stressful one for students who are accustomed to performing well with little effort and now find themselves doing only average, or even poorly, in their course work, despite the long hours they feel they are putting in. Discussions with first-term freshmen have indicated that some would appreciate greater assistance from the faculty, or perhaps other counseling services, in making the high school senior to college freshman transition. Interviews with students who left the program corroborate the need for more guidance (see next section).

Differences Between ISP and non-ISP Science Students. Overall, the preceding analyses revealed that ISP is viewed more positively than the regular university program is by equally superior non-ISP science students. Generally, ISP students are more favorably impressed by the personal qualities of their fellow students (Factor D1), their interaction with students and instructors (Factor 12), and the quality of their instruction (Factor CJ2), but do not indicate a greater level of overall satisfaction (Factor CJ1) with their program than selected non-ISP students in the sciences at Northwestern. Furthermore, with regard to their assessments of fellow students and the quality of instruction, ISP freshmen feel more positively about these issues than do non-ISP freshmen, and this enthusiasm is maintained throughout the sophomore year, while non-ISP students show a significant decline in enthusiasm over the same period. On the other hand, the three factors of which sophomores are perhaps better judges than freshmen (interaction, freedom, and group study) show the reverse pattern, with ISP scores holding closer, in both years, to those of non-ISP sophomores, who again differ significantly from non-ISP freshmen.

Given the above pattern, the failure to find differences between ISP and non-ISP students on the factors of Satisfaction, Standards, and Integration may appear discrepant. The latter two, however, are easily accounted for. In the case of Standards, the scores of the non-ISP students are sufficiently high that simple ceiling effects appear sufficient explanations for the failure of ISP students to significantly exceed those values. With regard to Integration, it should be noted that although the omnibus F for this factor fell short of statistical significance, the difference between the means of the two sophomore groups (.74) is as large as any of the others that proved significant at the .01 level, while that for the freshmen (.37) appears just to miss the .05 criterion. In both cases ISP students do perceive their program as more integrated than do non-ISP students.

The failure to find differences with regard to Satisfaction, finally, appears to indicate differences in expectations more than differences in evaluation. That is, since ISP freshmen score higher than their non-ISP counterparts on six of the eight factors, it appears clear that they think more highly of ISP than non-ISP students think of the general science program. Further, since most of these factors also show a (non-significant) decline in scores as these students progress to the sophomore year, it appears reasonable to extrapolate backwards to posit even higher expectations at the beginning of the freshman year: ISP is, after all, a unique program and these students are clearly aware of this fact. Non-ISP students, however, would neither feel this uniqueness nor generate the same high level of expectations. The matching Satisfaction scores in the two groups would then merely indicate that each group is, more or less, getting what it had expected.

4.3 Attrition

In any innovative program there will inevitably be those who are dissatisfied and decide to leave. It is important that their reasons for dropping out of the program be understood so that adjustments can be made. As Table 4-5 indicates, attrition has been a considerable problem in ISP with almost half of the students in the first two classes leaving the program (i.e., 13 and 14 of 30, respectively). So far 27 of the first 60 students (or 45%) who enrolled in ISP have left. Most of the attrition appears to occur during the first year of the program, with 8 of the 13 dropouts in the first class leaving then and (to date) nine of the 14 dropouts from the second entering class.

In order to understand the attrition problem, a special study was performed. In the spring of 1978 interviews were conducted with most of the students who had left ISP. Of the 12 students leaving--10 sophomores

Table 4-5.

ISP Attrition

	Quarters									
Year Enrolled	1	2	3	4	5	6	7	8	9	Total
1976	2	4	2	2	2	1	0	0	-	13
1977	1	1	7	5	0	-	-	-	-	14
1978	3	0	-	-	-	-	-	-	-	3
										30

and two freshmen--eight were interviewed. Of those interviewed six were sophomores and two freshmen. Two students could not be reached; one was discarded because he had been in the program for such a short period of time, and one refused to be interviewed.

The interview questions are listed in Table 4-6. All students were asked a number of open-ended questions (#1, 18-23) about ISP as well as a sequence of structured questions (#2-17) about specific aspects of the program that may have influenced their decision to leave the program. The interviews lasted about 45 minutes. Most of the students interviewed were very cooperative and appreciated the opportunity to talk about their ISP experiences. They all seemed to have carefully considered their decision and had no trouble expressing themselves. In many cases, the statements offered for rating evoked enthusiastic agreement and additional comments not previously made in response to the open-ended question.

The responses to the questions including representative sample comments are also presented in Table 4-6. There were four general reasons given for withdrawing from ISP (#1). These concerned the student's career goals, the time the program involved, the curriculum, and the grades received, in order of decreasing importance. Most of the responses are reflected in the responses to the specific questions as well.

Career Goals. The most frequently cited reason for leaving ISP was a change in career goals. This is supported by the responses to questions 9 and 15 as well--the two highest rated factors for leaving ISP. All the students agreed that the most important reason for leaving ISP was that it "was not leading in the direction" they were interested in (#9). Five of the eight also indicated that their "career goals changed" (#15).

Table 4-6

Interview Questions and Responses of ISP Dropouts

Question	Mean[a]	S.D.	Sample Comments
1. Why did you withdraw from ISP?	-	-	I couldn't see a job at the bachelor's level and didn't plan to go on. (7)[b] Too much time required. (7) The classes were above my level--chemistry especially. (4) I got a "D" in chemistry and couldn't retake the course. (3)
2. The pace of the class was too fast?	4.25	1.83	Math was fine, but chemistry and physics were too fast.
3. I didn't like the curriculum?	4.14	1.68	Math was fine, but chemistry and physics were bad.
4. I didn't like the ISP Faculty?	1.63	1.41	The physics teacher was "mean" and "scary."
5. After doing so well in high school, I didn't like getting lower grades:	2.88	1.73	
6. I felt that my grades did not reflect the amount of work I was putting into my studies:	3.25	2.31	
7. There was too much work involved in the program:	4.13	2.03	
8. I felt the pressure was too great--too much is expected from ISP students:	4.25	1.83	
9. I felt the program was not leading in the direction I wanted to go:	6.38	.74	It wasn't leading in any direction.
10. I understood what the program was about when I applied:	2.50	1.41	I had a higher expectation of personal contact with the faculty.

Table 4-6 Cont'd.

Question	Mean[a]	S.D.	
11. The program was too diffuse for me--I wanted to concentrate my studies more on one area:	3.13	2.36	It's all too general--more concrete work is needed.
12. The program was too structured for me--I wanted more choices in my program:	3.75	1.91	Everything was decided for us--I couldn't explore other areas.
13. I found myself taking too many courses in which I was not interested:	3.63	2.20	
14. I didn't like the sequence in which the courses were offered:	1.75	1.04	Organic chemistry and C33 are offered too early.
15. My career goals changed while I was in the program:	4.25	2.76	
16. I felt isolated from the rest of the student body:	2.50	2.51	
17. I disliked the thought of having so many of my classes with the same people day after day, year after year:	3.00	2.45	Those particular people--strange, wierd inhuman, too technical.
18. If you indicated that you disliked the curriculum, what did you dislike about it?	-	-	Chemistry was above my level. (3) I felt like I didn't learn much in computer science (2). The first three quarters were really good--after that, too theoretical, too abstract--I would like more concrete work to keep up my interest.
19. What changes would you like to see in the program?	-	-	Teachers should be more sensitive to the difficulties of the incoming freshmen merging into the program. Overall, too much too fast. Take up less time in the day--too little time to myself.

Table 4-6 Cont'd.

	Question	Mean[a]	S.D.	
20.	Had these changes been in effect when you were in ISP, would you still have dropped out?"	-	-	Yes (4), No (3), Uncertain (1)
21.	Do you regret your decision to leave ISP?	-	-	No (7), Somewhat (1)
22.	Were it possible, would you consider changing back to ISP?	-	-	No (7). I can take the same courses anyway, leaving out the subjects I don't want.
23.	Is there anything you would like to add to what you've already said?	-	-	The program is great for students who want a broad science base. The teachers are unapproachable--overly imposing. It was interesting while I was in it--I changed--I found what I wanted to do. My quarters were good and beneficial, but it didn't continue to benefit me--it's a good program, just not for me.

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[a] On a scale from 1 to 7 where 1 is not a factor in dropping ISP and 7 is a primary factor.

[b] Number of students making similar comments.

Most students commented that they were interested in more "practical work" and were not interested in getting an advanced degree. Thus they switched to programs that would allow them to get a job after four years of undergraduate study. In fact, of the eight students interviewed, six had transferred into applied programs--four in engineering and one each in computer science and economics.

Time. The workload imposed by ISP was also frequently cited as a significant factor in leaving the program. From almost all the students, terms such as "oppressive," "crushing," "staggering," "too much," "too fast," "overwhelming," "intense," "above my level," etc. were voiced repeatedly, accompanied by shrugs, rueful smiles and shaken heads. These points are corroborated in Questions 2, 7, and 8--the next most highly rated group of factors for leaving ISP--as well as in Question 19. As the ratings indicate students generally agreed that the "pace ... was too fast" (#2), "there was too much work" (#7), and that "the pressure was too great" (#8).

Several students commented that the transition from high school to college is made even more difficult by the exacting standards of a program like ISP. A couple of students felt totally unprepared for the intensity of the program and suggested an optional seminar during "new student week" on how to approach and study for ISP courses.

Curriculum. Problems with the curriculum were also frequently mentioned as factors in leaving the program. ISP was felt to offer too little choice in electives and require too much time in scheduled classes. Some students also thought (mistakenly) that the ISP curriculum could be duplicated by taking other larger courses. Since the freshmen chemistry courses were taught as special sections of larger courses, this has probably led to their confusion.

All courses received some criticism (#18). However, the computer science course was repeatedly singled out as a problem since it was superimposed over the four regular classes rather than being offered as a separate course. In addition, chemistry was frequently mentioned as being over the student's head.

These points are corroborated by the responses to questions 3, and 11-14--the next most highly rated group of factors for dropping ISP. Five of the eight students "didn't like the curriculum" (#3). The same number also found it "too diffuse" (#11), "too structured" (#12), and containing courses they were not interested in (#13). Only one person indicated that the "sequence" of the courses was at all a factor in leaving (#14).

On the other hand, the faculty was not seen as a factor in leaving the program (#4). This question received the lowest rating. However, a few students commented that the professors were intimidating, distant, and not always sensitive to the problems faced by ISP freshmen.

Grades. Related to problems just noted with the curriculum are the specific grades received in courses. Only one student did not consider grades to be a factor in leaving ISP (#5 and #6). Most students did not mind receiving lower grades than high school, but three of them were quite unhappy with the work they put in for a poor grade. As we noted in Chapter 3, however, grades for ISP students were not inconsistent with those for other students.

Social Climate. Another factor brought up often enough to be worth mentioning is the social atmosphere in the program. While isolation from other students was not seen as a problem (#16), the students enrolled in ISP were seen by some as being a factor in their decision to leave (#17). The

ISP students were sometimes described as "strange" or "erratic." Several students suggested interviewing applicants more carefully.

Overall, the problem of student attrition seems largely to reflect changing career goals and related adjustments to college life (i.e., study habits, grades, etc.) that most severely affect freshmen. Most of these were changes in the students' interests and do not reflect lack of appropriate information about ISP (#10). Although students did recommend some changes in the program (#19), they did not believe that such changes/alterations would have changed their decision to leave ISP (#20-22). Such attrition is likely to characterize any new program oriented toward freshmen. For example, we examined the attrition in the freshmen honors science courses and found it to be 73%.

Prediction of Dropouts. A question of concern to any educational program is that of identifying students who may for one reason or another drop out of that program prior to completion. This issue was considered both from the standpoint of the Student Survey questionnaire and subsequently through the use of several other devices.

In terms of the eight key factors derived from the Student Survey, June 1978 responses of those 13 students who subsequently dropped out of the program differed from those of the 31 who have remained in it in their scores on only one factor: Factor J1, Satisfaction ($\underline{t} = 2.15, < .05$). A further scan of the individual variables (including those not contained in these factors) indicated differences of comparable magnitude on variables A4 (attendance at musical or theatrical events), E4b (percentage of non-Academic time spent with other ISP students), H11 (importance of broad curriculum), J1 (satisfaction with ISP), and J6 (how does ISP compare with other Northwestern science programs?)

Multiple regression analyses of these variables indicated that only three contributed significantly to the differentiation of the drop-outs from the non-drop-outs: A4, E4b, and J1. For these three variables, the multiple correlation with the drop-out/stay-in criterion, over these 44 students, was .67, with the associate F (10.00) significant well beyond the .001 level. A simple scale was constructed of these three variables and roughly weighted to account for the fact that each used a different metric, to yield a composite score according to the formula $R = J1 + 3(A4) + (E4b)/20$, which ranged from about 1 to about 7.

Of the thirteen students who eventually dropped out of ISP, only one achieved a score higher than 5.50 on this scale, while 27 of the 31 students who remained in the program scored higher than that value (for these calculations, missing values were replaced by the group mean). This cut-off point thus yields only 4 false positives and 1 false negative, for an overall accuracy rate of 89%. While this is encouraging, it should be born in mind that this formula is based on the best possible selection of variables from this entire set; and may not mean much until adequately cross-validated.

Although earlier analyses had indicated that data collected from ISP students in the Fall quarter differed in many respects from that collected in spring, and although it appeared reasonable to assume that whatever factors might contribute to a student's ultimate decision to drop out of ISP would barely have had time to formulate themselves by the end of student's first quarter, it was also apparent that the above "drop-out" scale had to be cross-validated before it could be given much credence. The Fall data were the only set available for such cross-validation attempts. Consequently, the multiple correlation of the three key variables (A4, E4b, and J1) with the drop-out/stay-in criterion was calculated on the basis of the Fall 1977 and Fall 1978 data (N = 60, including 16 drop-outs). This multiple correlation of .35 (with an associated F of 2.62) proved significant at the .05 level, one-tailed, with a pattern of weighting quite comparable to the original formula. (The multiple correlation based on only J1 and E4b was .345, significant at the .01 level). While these results certainly reflect the anticipated shirnkage, it appears encouraging to note that the three items also managed to achieve a meaningful level of differentiation in this sample.

A number of other approaches to predicting dropouts were also tried. These involved correlations with GPA and SAT, and multiple regression using the Fall Survey data. Both approaches were less successful than the three-item scale. Thus, while it appears premature to suggest that the present three-item drop-out scale is in any sense definitive, there appears to be ample indications that a scale identifying potential dropouts could be developed. If these potential dropouts seem to feel that they both know what they want from their undergraduate education and know that they won't get it within ISP, the most prudent action might be simply to support them in their decision to leave. In the case of those who appear less certain of their educational goals, however, increased counseling and guidance might lead them to feel more satisfied with ISP and more comfortable with their fellow ISP students. These more positive attitudes probably would lessen the likelihood that they will leave ISP.

Recommendations. This research leads to a number of recommendations. In order to deal with student attrition, ISP should consider instituting two changes. The first involves a more careful assessment of students' career goals. This could be made part of the final admission procedure.

Specifically, information should be obtained from the student on the application form. This could be followed with a phone interview from the ISP Director before an admission offer is made.

Second, ISP should institute a formal counseling procedure. Each student should be assigned a faculty advisor and meet with him or her at least once each quarter. In addition, the Director should also be available to meet with students. This could be done through regularly scheduled office hours and other informal activities such as coffee breaks or lunches. Again, the first year is probably the most critical, and the advising system may only be necessary for freshmen.

Reference Note

1. Wilson, J. R., & Ihlanfeldt, W. I. A report on the freshman year 1972-73 to the committee on educational policies from the Planning Department and the Office of Admission--Revised. Duplicated manuscript. Evanston, Ill.: Northwestern University, March, 1974.

5. OUTCOMES

5.1 Introduction

One of the most important goals of ISP is to encourage students to pursue a career in the sciences, especially the emerging integrated fields. In particular, it was anticipated that most graduates would obtain training beyond the B.A. degree. Since this report was due shortly before the first ISP class graduated, two approaches to determining the effect of ISP on students' career choices and graduate training opportunities were employed. First, the 15 students in the first graduating class were interviewed shortly before completing ISP. Second, a survey questionnaire was constructed and mailed to the leading graduate science departments.

The results of these investigations are presented in the next two sections. Both of these studies provide preliminary information on the likelihood that ISP will achieve its ultimate goal of producing competent and talented "panscientists." However, it should be emphasized that at this time these findings are tentative and should be viewed as suggestive of the impact of ISP on students' careers. Only careful monitoring of ISP graduates' career choices over an extended period of time will reveal the pattern of outcomes clearly enough for more firm conclusions to be reached.

5.2 Third-year Student Interviews

Interviews were conducted with the fifteen third-year ISP students during late February and early March, 1979. All interviews were held in the ISP lounge and lasted about 15-20 minutes. The interviews were intended to determine the students' satisfaction with ISP and their plans for the future.

Interview Questions. The interview format was the same for all students. There were 18 questions (see listing in Table 5-1). The first 12 questions dealt with the students' experience in ISP; four of the remaining questions (#13, 14, 15, 18) dealt with the students' plans for the future (whether they would be at Northwestern next year, plans for graduate study, and career choices). There was a question dealing with how their experience in ISP affected their plans (#16), and finally there was one question concerned with nether they would enroll in ISP, and attend Northwestern if they had it to do over again. On the first question, dealing with characteristics of ISP which were important in the students' decision to enroll, spontaneous answers were first recorded and then students indicated whether each of a list of ten program characteristics was important. Four of the items had a seven-point response scale; six of the questions were of yes-no format, and the rest were open-ended.

The results are summarized in Table 5-1. Means and standard deviations were calculated on the seven-point response scales. For the remaining questions, percentage of responses were calculated.

Important Program Characteristics. Approximately 25% of those interviewed spontaneously mentioned the accelerated nature of the program, a curriculum that integrates the natural sciences, close associations with faculty, or being allowed to avoid deciding on a major as important characteristics affecting their choice to enroll in ISP (see Question 1). When they were read a list of program characteristics and were asked to indicate which were important in their decision to enroll, all students said that a curriculum integrating the natural sciences was important; enrollment in a special program had the next highest affirmative response.

Table 5-1

Interview questions and responses of third-year ISP students.

Question	Response	
1. Think back to your decision to enroll in ISP. What characteristics of ISP were important determinants of your choice?	Noted spontaneously[a]	Elicited[b]
a. Three-year bachelor's degree		60 %
b. Close associations with faculty	20 %	73.3%
c. Association with a small group of students with superior records	20 %	60 %
d. Curriculum that integrates the natural sciences	26.7%	100 %
e. Possibly greater appeal to graduate school admissions		46.7%
f. Curriculum that is uniformly rigorous	20 %	53.3%
g. By-passing lower-division science courses	26.7%	73.3%
h. Enrollment in a new program	6.7%	53.3%
i. Enrollment in a special program	20 %	86.7%
j. Allowed me to avoid deciding on a major	26.7%	66.7%

2. Did ISP turn out to have the characteristics which influenced your choice?	Yes	80%
	No	0%
	Yes and no	20%

3. In general, how similar has your ISP experience been to what you expected when you entered the program?

1 2 3 4 5 6 7

not at all similar — very similar

$\bar{x} = 4.92$

s.d. = .76

4. How satisfied do you feel with your overall experience in ISP?

1	2	3	4	5	6	7	
not at all satisfied						very satisfied	$\bar{x} = 5.20$ s.d. = 1.21

5. What, if anything, have you especially liked about the academic aspects of ISP?[c]

high quality professors	26.7%
acceleration	26.7%
integration	26.7%
level of courses	20 %
close contact with faculty	13.3%
opportunity for independent study	13.3%

6. What, if anything, have you especially disliked about the academic aspects of ISP?[c]

inflexibility of course schedule	26.7%
some courses not integrated	20 %
start-up problems with new courses	20 %

7. If you were planning your undergraduate education now, what changes, if any, would you make?

None	53.3%
Would do more research	13.3%

8. Would you recommend a program like ISP to other qualified students interested in science?

Yes, without qualification	40 %
Yes, with qualification	46.7%
No	0 %

9. What, if anything, have you especially liked about the non-academic aspects of ISP?[c]

working with the same group of students	73.3%
facilities	40 %

10. What, if anything, have you especially disliked about the non-academic aspects of ISP?[c]

Lack of counseling	20 %

11. How do you think your overall satisfaction with your undergraduate experience thus far compares with that of non-ISP students?

1	2	3	4	5	6	7	
less satisfied than most						more satisfied than most	$\bar{x} = 5.86$ s.d. = .95

12. How do you think your overall satisfaction with your undergraduate experience thus far compares with that of other ISP students?

1	2	3	4	5	6	7	
less satisfied than most						more satisfied than most	$\bar{x} = 4.92$ s.d. = 2.31

13. Do you plan to be at Northwestern next year?

Yes	66.7%
No	13.3%
Uncertain	20 %

14. Do you plan to earn any degrees other than your B.A. in science?

Yes	80 %
No	13.3%
Uncertain	6.7%

If yes, please indicate what degrees you plan to earn, what fields you plan to study, and what universities you might attend.

Field	Number considerin
Physics	4
Chemistry	2
Math	1
Integrated sciences (biology, biochemistry meteorology, astronomy)	6
Engineering	1
Medicine	7

15. Have you decided what career you'd like to pursue?

Yes	53.3%
No	47.7%

If yes, what career have you chosen?
If no, what careers are you considering?

Field	Number considering
Physics	4
Chemistry	2
Math	1
Integrated sciences (biology, biochemistry, meteorology, astronomy)	6
Engineering	1
Medicine	7

16. How has your experience in ISP influenced your career choice, choice of graduate school, and field of study?[d]

17. If you had it to do all over again:

a. Would you enroll in ISP?

Yes	100%
No	0%

b. Would you enroll at Northwestern?

Yes	66.7%
No	33.3%

18. If you are applying to graduate school, which ones did you apply to? Have you been accepted by any? Which?[d]

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a. Comments freely offered by students that closely resemble the specific characteristics requested.

b. Percentage indicating that each of the specific characteristics was important.

c. Response categories were extracted from student responses.

d. See text for discussion.

All program characteristics, except its "greater appeal" to graduate schools, were endorsed by the majority of students.

Eighty percent of the students said that ISP had the characteristics which influenced their choice to enroll, while 20% indicated that the program had only some of these characteristics (see Question 2). There were few comments on this question, but the most frequent comment (made by 2 students) was that some of the courses, particularly chemistry, were not well integrated.

Satisfaction With ISP. Overall, the students' ISP experience was rated as being similar to what they expected when they entered the program (see Question 3), $\bar{x} = 4.92$, sd = .76, on a scale from 1 (not at all similar) to 7 (very similar). Generally, the students were satisfied with their experience in ISP (see Question 4), $\bar{x} = 5.2$, sd = 1.21 on a scale from 1 (not at all satisfied) to 7 (very satisfied).

Among the academic aspects of the program which the students particularly liked (see Question 5), the three most frequent responses were the high quality of the professors, the integration of the sciences, and the acceleration of the program, each of which was mentioned by approximately 25% of the students. There were fewer and more varied responses to the question of which academic aspects they particularly disliked (Question 6). The most frequent response category was the inflexibility of the course schedule and program requirements. For example, the ISP sequence interferes with students getting dual majors, particularly in chemistry and biology. Approximately one fourth of the students mentioned these. Most of the other comments pertained to the problems of a growing program. For example, some of the courses weren't fully integrated; and since they were the first class to go through the program, they encountered all the problems associated with new courses.

When asked what changes they would make if they were planning their undergraduate education now (Question 7), about half of the students said they would make no changes. The only other response made by more than one person (i.e., two) was that they would do more research. This was consistent with the preliminary results of the Graduate School Survey, where the lack of research experience was shown to be a major shortcoming of the program, as far as many schools were concerned (see Section 5.3).

Forty percent of the students said they would recommend, without qualification, a program like ISP to other qualified students interested in science (Question 8). About half of them said they would recommend it, with qualification, while the remaining students did not know. The most frequently mentioned qualifications were that a person should not enroll in the program if (s)he already has a good idea of what field (s)he wants to go into (20%) and (s)he must have motivation and dedication (13.33%).

Satisfaction With University Environment. When asked what they had especially liked about the non-academic aspects of the program (Question 9), nearly three-fourths of the students mentioned the social cohesion engendered by working with the same group of students for three years. Many of the students (40%) mentioned the facilities (the lounge and the terminal room).

Few students answered the question concerning non-academic aspects which they had particularly disliked (Question 10). Among those who did answer, the only response made more than once was that there is a need for more counseling in the program.

The students felt that their satisfaction with their undergraduate experience compared favorably with that of non-ISP students. $\bar{x} = 5.86$, sd = .95 (Question 11) on a scale from 1 (less satisfied than most) to 7 (more satisfied than most). In comparing their satisfaction with that of other ISP students, they rated themselves as slightly more satisfied, though there was large variation in the responses; $\bar{x} = 4.92$, sd = 2.31 (Question 12).

Career Plans. Ten of the students plan to be at Northwestern next year; two of the remaining students do not plan to be here, while the other three are uncertain (Question 13). Among the students who plan to be here next year, nearly all (7) of them will be getting a dual major in a science (Question 14). Two will be getting a Master's degree, one after obtaining a double major this year. One student is not getting an ISP degree, but a degree in biology. Whether the other students take the three-year B.A. option is dependent upon whether they are admitted to graduate school or are successful in finding a job.

All but one of the students, who is uncertain, are planning to get a post-graduate education. One studentis planning to attend law school, while all the other students are going into medicine or a science. Some students mentioned more than one field of study they were considering. Other than medicine, the most frequently mentioned fields were the integrated sciences. Nine students are considering getting a Ph.D. while only one student is definitely planning to obtain a Master's degree.

Approximately half the students have decided what career they would like to pursue (Question 15). The careers which the students have chosen or are considering are research positions in the fields they are planning to do their graduate work in. In fact, two students have applied to graduate schools — one in medicine, the other in biochemistry (Question 18). One has been accepted into medical school at Ohio State, the other has not been accepted. The schools they applied to and the ones other students mentioned as possibilities are, in general, highly rated schools that correspond to ones participating in the Graduate School Survey (e.g., Ohio State, University of Michigan, Berkeley, Case Western Reserve, and Northwestern).

All the students said their experience in ISP had not affected their choice of graduate school, and most felt that it had not specifically affected their choice of career or field of study (Question 16). Three students said it had affected their career choice by exposing them to a wide range of fields, enabling them to choose the ones which appealed to them. Two students said that from their experience they learned they did not want to do scientific research.

Overall Satisfaction. All the students indicated that they would enroll in ISP if they had it to do over again (Question 17), though one-third said they would not enroll at Northwestern. The latter said they would enroll in ISP at another university, if it were offered.

5.3 Graduate School Survey

As part of the ongoing evaluation of ISP, an eight-item questionnaire was designed and sent to chairmen of science departments at major graduate institutions in the United States (see Table 5-2). The questionnaire attempted to address three related questions? 1) How was ISP perceived by other leading institutions? 2) How would the training provided ISP students be evaluated by graduate admission committees? and 3) What changes in ISP might be considered in order to meet graduate admission requirements?

Sample. The primary targets for this questionnaire were those university departments that had received ratings ranging between 2.0 and 3.0 in the American Council on Education's (ACE) 1969 ratings of "effectiveness of doctoral program" in the disciplines of Astronomy, Biochemistry, Chemistry, Geology, Mathematics, Microbiology, Molecular Biology, Population Biology, and Physics. Other leading departments in disciplines not considered by the ACE (e.g., Computing Sciences, Oceanography) were also included on recommendation of the ISP staff.

In June of 1977, 115 departments were mailed a packet of materials, each consisting of the questionnaire, a two-page description of the program, a five-page curriculum outline (see Appendix B), and a cover letter. In January 1978, a preliminary summary of 72 responses (63%) to this mailing was circulated to ISP staff and evaluators. On the basis of comments received at this time, a slightly revised questionnaire was prepared, differing from the original primarily in that it made response options more precise and detailed. Two judges converted the verbal descriptions provided by respondents to the first mailing to the

Table 5-2

Graduate School Survey Questionnaire

Please circle the appropriate response and explain where requested.

1. Would an ISP student with a strong undergraduate record (say ISP grade average > 3.5 (where A = 4.0), and GRE verbal and quantitative > 700, faculty recommendations indicating high potential for achievement in science), be admitted as a graduate student in your department with no course work beyond that given in ISP?

4	5	2	1
very likely	likely	unlikely	very unlikely

Assuming admission, please indicate probability of financial aid.

4	3	2	1
very likely	likely	unlikely	very unlikely

2. Please indicate what course work in your discipline beyond that given in ISP (see enclosure) would be (a) required (b) recommended, for ISP students to take at Northwestern in order to be admitted as a graduate student in your department.

   a. Required courses

   b. Recommended courses

3. a. Is the GRE Advanced Score in your subject (i.e. beside quantitative and verbal scores) important in graduate student admission in your department? Yes___ No___.

   b. If "no", would you find it useful information? Yes___ No___.

4. a. Would a commitment to take appropriate courses in the last year at Northwestern replace the GRE Advanced score for admission of an achieving ISP student?

   Yes________ No________

   b. If "no", would such coursework be helpful? Yes___ No___.

5. Please give your opinion of ISP as an undergraduate background for a Ph.D. level scientist in your discipline.

4	3	2	1
Excellent	Good	Adequate	Inadequate

Please explain.

6. How does the mathematics content of ISP compare with what you'd like to see students have and with the math background of other students entering graduate school in your discipline?

4	3	2	1
Excellent	Good	Adequate	Inadequate

Please explain.

7. Would a similar program be of value in your university?

Yes___ No___

Please explain.

8. What changes in the ISP curriculum would you suggest?

Paul M. Wortman
Director, ISP Evaluation
Psychology Department
Northwestern University
Evanston, Illinois 60201

categories supplied in the second mailing, for questions 1, 5, and 6. This questionnaire with the supporting documents was sent to 53 departments, 10 of which had not received the first mailing.

Response. Thirty-one departments responded to the second mailing for a total of 103 departments representing 20 different institutions. The response rate to this survey by location and department is provided in Table 5-3. Overall, 82% of the departments completed and returned the questionnaire. Of the 125 different departments contacted, 56 were in the East, 39 were in the Midwest, and 30 were situated on the West Coast. Of these, the Midwestern institutions appeared most likely to respond (92% response to the combined mailings, as compared with 79% in the East, and 77% in the West). The sample was also sorted into seven disciplinary groupings. The response rate ranged from a low of 50% for Computer Science to a high of 100% for Astronomy and Chemistry. Apparently either the program or the questionnaire was somewhat more attractive, as indicated by response rates, to the more established sciences like Astronomy, Chemistry, Mathematics, and Physics, than to the relatively younger disciplines.

The results of the survey are presented in Table 5-4. For questions 1, 5, and 6 the means and standard deviations on the four-point scales were calculated separately for disciplines along with percentages. For the remaining questions (2, 3, 4, 7, and 8), only percentages of responses were calculated for each discipline.

Admission and Aid. Although 85% of those responding felt that an ISP student with a strong undergraduate record (e.g., GPA at least 3.5, GRE verbal and quantitative over 700, good faculty recommendations) would be likely to be admitted to their graduate departments, only 77% felt such

Table 5-3

Response Rate by Location and
Dependent to Graduate School Questionnaire

Departments	Contacted	Response Rate (percent)
Location		
East	56	79
Midwest	39	92
West	30	77
Discipline		
Astronomy	10	100
Biology	17	76
Chemistry	20	100
Computer Science	8	50
Earth Sciences	27	74
Mathematics	24	83
Physics	19	84
Total	125	82

Table 5-4

Response to Graduate School Survey Questionnaire

Questions

		1a		1b		3a	3b	4		5		6		7	
Discipline	N	$\bar{X}$	SD	$\bar{X}$	SD	Yes	Yes	Yes	No	$\bar{X}$	SD	$\bar{X}$	SD	Yes	No
Astronomy	10	3.10	.99	3.00	.67	7	3	2	8	2.90	.49	3.00	.39	4	4
Biology	13	3.38	.55	3.50	.50	5	1	0	10	3.31	.40	3.38	.38	3	3
Computer Science	4	3.00	1.33	3.25	.92	3	0	1	1	2.88	1.73	3.38	.23	0	2
Earth Sciences	20	3.78	.22	3.50	.58	4	4	5	10	3.55	.58	3.68	.32	13	4
Chemistry	20	3.33	.69	3.55	.68	7	7	8	8	2.90	.59	3.48	.30	10	5
Mathematics	20	2.95	.79	2.55	.87	9	7	7	9	2.78	.85	2.58	1.01	7	4
Physics	16	3.19	.70	3.31	.36	7	8	1	11	3.06	.66	3.25	.30	5	5
Total	103	3.29	.68	3.24	.73	42	30	24	57	3.08	.69	3.24	.58	42	27
Percent Favorable		85		82		41	29	23	55	87		90		41	26

applicants would be likely to receive financial aid granted admission (Question 1). There was some indication that the GRE advanced score is important for decisions concerning financial aid, thus explaining the discrepancy (Question 3). For this, 41% of respondents felt this score to be important, while an additional 29% indicated that it would be useful. Furthermore, only 23% of respondents indicated that a fourth year at Northwestern with a commitment to take appropriate courses would serve as a replacement while 55% said it would not for the GRE advanced score (Question 4). But this last figure must be interpreted with care, as some respondents suggested in their comments that a "no" response to this question meant the fourth year was unnecessary, while others indicated that "no" meant the fourth year was insufficient (and still others failed to indicate which of these was intended). In general, if an applicant's GPA is reasonably high (3.5) and the GRE scores fall above the 80th percentile, admission to most graduate departments appears likely (see Question 6). A number of schools expressed optimism about the three-year ISP graduate's showing on the GRE.

Overall Assessment. Overall, ISP was rated as "good" ($\bar{x} = 3.08$, s.d. = .69) with 87% of respondents rating it as more than adequate (i.e., either 3 or 4 on the 4-point scale) compared to the undergraduate background of Ph.D. scientists in their discipline (Question 5). Math departments accounted for 46% of the 13% dissenting respondents. The results indicate that the math content of ISP was rated as slightly better than "good" ($\bar{x} = 3.24$, s.d. = .58), with 90% rating it as more than adequate by the standards they would wish to apply to entering graduate sutdents (Question 6).

Again, math departments accounted for 70% of the dissenting 10%.

Two-fifths of the respondents (41%) felt a program similar to ISP would be of value at their university, while only one-quarter (26%) disagreed (Question 7). The major deficits in ISP perceived by this latter group were the program's apparent lack of flexibility, laboratory experience, and independent projects. In a related question (#2), requesting additional courses that would be required of ISP graduates seeking admission to graduate study, research and laboratory experience was mentioned by three of the seven disciplinary groups. Only 25% of all respondents, however, listed any such courses (Question 2). Astronomy, Biology, Computer Science and Earth Science departments tended to list general topics rather than specific courses, while Chemistry, Math and Physics tended to be more specific, with several respondents going so far as to cite the appropriate texts.

Mathematicians appeared least receptive to three-year ISP graduates. In their opinion ISP is almost a "good" ($\bar{x}$ = 2.78, s.d. = .85) undergraduate background for Ph.D. scientists (Question 5), with a slightly better than adequate ($\bar{x}$ = 2.58, s.d. = 1.01) math content compared to what other students entering graduate school have, or to what they would like to see students have (Question 6). Although Math departments are least likely to admit three-year ISP graduates, they consider admission to be likely ($\bar{x}$ = 2.95, s.d. = .79). Mathematicians appear to favor more advanced courses within the student's area of specialization and appear somewhat less critical, as a consequence, of ISP graduates who specialize in a fourth year.

Institutions Assessment of ISP. In order to assess general trends across institutions, rather than disciplines, the means of those items (1a, 1b, 5 and 6) which allowed scaled responses (i.e., 1 to 4) were calculated across disciplines for all institutions which provided more than 2 responses. The resulting 14 institutions were rank-ordered on each of the four questions, and mean ranks calculated (see Table 5-5). The three institutions achieving mean rank scores less than 5 were all Midwestern unversities; all but one of the institutions achieving means rank scores between 5 and 8.00 were from the East; and all three Western schools had scores of 8.0 or higher.

Aside from the apparent local bias of Illinois universities, two possible explanations for this pattern were hypothesized: the possibility that it was Northwestern, rather than ISP that was being rated, and the possibility that regional differences in educational philosophy (with the East as the representative of traditional, broad educational patterns, and the West as representative of newer, more "relevant" approaches) had affected the ratings. It was not possible to address the first issue. The second possibility, concerning regional differences in educational philosophy, appeared to find some support as indicated by the (open-ended) responses to question 8, asking for suggested changes in the ISP curriculum. These responses were grouped into six categories, and the relevant percentages were calculated. Eastern universities appeared most concerned that ISP be more flexible (20%) and considered greater depth (35%) to be useful. Western universities, on the other hand, seem almost wholly unconcerned with flexibility (5%), but consider further specialization (42%), or a fourth year (37%) useful. Midwestern universities, finally, do not

Table 5-5

Mean Ranking on Questionnaire Items of Institutions With Three or More Departmental Responses.[a]

Institution	Mean Rank	Institution	Mean Rank
U of I -CC	1.25	Harvard	7.50
U of Chicago	2.63	Yale	7.63
U of I - UC	4.75	U of C - Berkeley	8.00
Princeton	6.00	Stanford	10.73
J Hopkins	6.63	MIT	11.50
U of Michigan	6.75	U of Wisconsin	12.38
Brown	6.88	Cal Tech	12.50

[a] Rankings from 95 departments.

see a need for a fourth year (only 2% indicating it might be useful), but tend to emphasize the need for more independent projects (28%) or lab work (31%), as well as greater depth (28%).

Conclusion. Eighty-five percent of the leading institutions are likely to admit three-year ISP graduates. It seems reasonable to assume that graduates of the three year program who take a fourth year of undergraduate work or apply to universities other than those sampled, will be extremely competitive. These data do not allow a determination of whether three-year ISP students are more or less acceptable than students from a more traditional program, given the same grade point averages and GRE scores. However, on a four-point scale (where 4 = very likely to accept) the mean acceptability of the three-year ISP graduates is sufficiently high (3.29) that it would appear that a graduate from a traditional program would not be in a significantly more favorable position than the three-year ISP graduate.

Appendix A

ISP Brochure

ISP Application

ISP

INTEGRATED SCIENCE PROGRAM

AT NORTHWESTERN

Northwestern University offers a unique undergraduate program of integrated science studies within the College of Arts and Sciences. The Integrated Science Program (ISP) is designed for a small group of students with superior high school records and strong motivation in science and mathematics. Its special curriculum provides a thorough and rigorous background in all the major scientific disciplines. It attempts, however, to integrate them into a unified whole and to diminish the sharp but artificial boundaries that traditionally separate them. ISP leads to a three-year bachelor's degree and further, to a number of options for dual majors or an advanced degree after a fourth year at Northwestern. Because it represents an important and innovative step in undergraduate science education, ISP has been provided a grant by the National Science Foundation.

Northwestern provides a dual advantage to students of science and mathematics: close associations with diverse types of scientists engaged in research at the forefront of science within an environment of the liberal arts. Scientific studies conducted in the surroundings of highly active humanistic and cultural endeavor make possible a truly liberal education.

WHY INTEGRATED SCIENCE?

The problems of the nation and society increasingly require the attention of scientists for their solution. Individuals of many backgrounds can detect the symptoms of major problems, but only scientists can effectively conduct the basic investigations that might discover their cause. More and more, multidisciplinary scientists are required who can work in concert with traditional specialists. Success in the careers of many scientists will increasingly depend on the flexibility with which an individual can change direction of his or her scientific studies. A multidisciplinary background provides the individual with a broad and flexible platform designed to keep pace with future trends and to maintain a wider employment potential.

In addition to its value in the preparation of scientists of the future, ISP students will obtain an overview of the sciences and of mathematics and will acquire a clear picture of the state of the art and a sense of the problems at the forefront. Such education allows flexibility in selecting degree and career options and provides an informed background from which to choose a field, either at the Bachelor's level or in graduate school. Thus, a student can avoid an arbitrary or premature selection of a science major. Further, students who decide to pursue interdisciplinary work, either in graduate school or in a job, will be well-equipped by an undergraduate integrated science education to identify and follow the most significant and interesting paths.

THE PROGRAM

The ISP curriculum is designed with two objectives: 1) to present an integrated, quantitative and accelerated treatment of the natural sciences and mathematics, and 2) to provide a superior academic background for graduate work in science and mathematics.

ISP begins with a rigorous four-quarter core sequence of physics, chemistry and mathematics, which provides the cornerstone to all further study in modern science. The core is designed to build on the advanced background of mathematics and chemistry which ISP students have had in high school and then move rapidly to treatments traditionally reserved for upper division courses. The core sequence is followed by four simultaneous advanced sequences in life sciences (biophysics, biochemistry, micro- and macro-biological systems), physical sciences (earth, moon, solar system, stellar systems, cosmologies), modern physics (particle and solid state physics) and mathematics (real analysis, probability).

The science-mathematics curriculum is the equivalent of 24 courses. In addition, ISP students take 12 courses in the humanities and elective subjects during the three-year duration.

The ISP curriculum balances the presentation of theory, laboratory work and computational instruction. The special ISP facility contains on-line computer terminals, some with video display, for problem-solving by students and for demonstration lectures. An advanced interactive computer graphics system is planned for the same facility. A five-week summer excursion observation in the Caribbean or western United States may precede the junior year. A continuing ISP seminar using visitors as well as Northwestern scientists serves as a special means for learning about current problems and research throughout the sciences.

Financial Aid

Nearly 50% of Northwestern students receive financial aid from some source. The majority receive assistance from funds administered by the University. All assistance awarded by Northwestern is based upon evidence of good scholarship and financial need. Students who wish to be considered for aid must have their family complete the Parents' Confidential Statement requesting that a copy of the form be sent to Northwestern.

HONORS SCIENCE PROGRAMS

Departmental Honors Science Programs (HSP) constitute a special option associated with ISP for superior high school students who want to major in a specialty field but who would like to gain the accelerated basic instruction in small classes of the ISP core sequence. Qualifications are identical for ISP and HSP, and students in both programs proceed through the four-quarter core sequence together. Thereafter, students who elect to follow HSP will transfer to one of Northwestern's science departments or to the Department of Mathematics to pursue specialized course work. Honors Science Programs in any of these departments lead to the Bachelor's degree in three years at Northwestern under the same conditions as for ISP (see Qualifications). At the end of the core sequence, HSP students may choose to remain in ISP, and at the same time, ISP students may transfer to HSP.

MAJORS AND DEGREE OPTIONS ASSOCIATED WITH ISP

ISP students have great flexibility in their choice of majors and degrees to be attained at Northwestern:

1. Single major—Bachelor of Arts degree in Science on completion of ISP; students with sufficient course credits on entrance can attain this degree in three years; others may require one or two extra quarters for graduation; a four year residence in ISP will allow students an even broader education in nonscience and science subjects.
2. Single major—Bachelor of Arts degree in a particular science discipline or mathematics on completion of Honors Science Program; the degree can be achieved in three years under the same circumstances as for ISP.
3. Dual major—the ISP major and a second major in one of the departments of science or mathematics, resulting in the Bachelor of Arts degree in science and a specialty (for example, chemistry); the dual major can normally be attained in a fourth year's residence at Northwestern.
4. Dual major—the ISP major and a second major in an interdisciplinary subject chosen by the student, resulting in the Bachelor of Arts in Science and the selected subject (for example, biogeochemistry); this dual major can also normally be attained in a fourth year's residence at Northwestern.
5. Two degrees in four years at Northwestern, the Bachelor of Arts for the ISP major and a Master of Science in one of the following: biological sciences, geological sciences, mathematics.

AFTER ISP

What will ISP students do after graduation with one of the degree options above? For those who choose careers in science or mathematics, graduate school at the doctoral level will commonly be the next step. There, they may pursue advanced studies in an interdisciplinary topic toward which ISP has provided initial insight. They may, alternatively, enter doctoral work in a specialty field equipped with a significantly different and broader scientific base than that provided by other undergraduate curricula.

Some ISP graduates may wish to go to professional schools such as medicine, law, or dentistry, or to do graduate work in the social sciences. Still others may decide to enter employment in industry or government directly after graduation. The ISP Director will supply information on the types of jobs for which a multidisciplinary scientific background will be particularly useful.

APPLICATION PROCEDURE

Prospective candidates must send a completed ISP application to the Director of the Integrated Sciences Program. The special application form for ISP may be obtained by sending in the form at the bottom of this page. A screening committee will review the application and notify the candidate of his or her viability for the program. Each candidate must also complete both the formal application and a regular application for the College of Arts and Sciences.

Decision Options

Northwestern offers ISP candidates the opportunity to apply under either Early or Regular Notification. The deadline for Early Notification is December 15 and decisions are mailed on February 1. Students thus accepted must notify the University of their decision to enroll or withdraw their ISP application by February 15. The deadline for Regular Notification is February 15. Students choosing this option will receive the decision in their case between March 20 and April 15 and must reply by May 1.

All candidates for this program must present the three CEEB Achievement tests in English Composition, Math II and Chemistry in order to be considered. Therefore, candidates choosing Early Notification must take the tests by the December testing date. Regular Notification candidates must take the tests by the January testing date.

QUALIFICATIONS FOR ISP

Entrance to ISP is selective and cannot accommodate all students interested in science. The program maintains small classes and low student/faculty ratios in order to maximize learning opportunities. Students with the following high school background will be most readily acceptable into ISP:

4 years of English
2-4 years of one foreign language
4 years of math, including a year of calculus
3 years of science (chemistry, physics, biology)
2-4 years of history or social science

Of these courses, calculus and chemistry are vital prerequisites to ISP. Nevertheless, students with outstanding records who have not had calculus or chemistry or who have attended schools that do not offer appropriate courses may still be considered for ISP. Such students, however, must be prepared to complete equivalent courses in calculus and chemistry during summer session following high school graduation.

Required are the College Entrance Examination Board Scholastic Aptitude and Achievement tests in English Composition, Advanced Mathematics (Level II) and Chemistry. Students will be admitted to ISP on the basis of his or her high school record, CEEB test scores, references from high school counselors or teachers, and involvement in science activities or special projects. SAT and Achievement test scores in mathematics and science of current ISP students nearly all exceed 700.

Graduation in three years requires the student to gain credit for the equivalent of nine university course units on the basis of his or her records in honors and college preparatory high school courses and results of CEEB Advanced Placement Tests. Students with records of high achievement in the curriculum recommended above have excellent opportunities to gain full credit. Other students who are acceptable into ISP but who cannot gain full credit will need one or two extra quarters work for graduation. University course credits will be assigned by the ISP screening committee and indicated on the notice of acceptance to ISP.

Specific questions on the content and objectives of ISP as well as matters of qualifications and admission should be addressed to Director, ISP, College of Arts and Sciences, Northwestern University, Evanston, Ill. 60201.

NAME ____

ADDRESS ____

PHONE ____

HIGH SCHOOL ____________________ ADDRESS ____________________

Please forward: An application for the Integrated Science Program ☐

A regular application for Northwestern University ☐

I am interested in information about the following:

____

____

____

ISP

The College of Arts and Sciences

NORTHWESTERN UNIVERSITY / EVANSTON, ILLINOIS

The Integrated Science Program

Application Instructions. Candidates who wish to be considered for the Integrated Science Program must complete this form and a regular application for undergraduate admission. Important dates for admission to both the University and the Integrated Science Program are

Early Notification: Deadline—December 15. Notification—February 1. Reply—February 15

Regular Notification: Deadline—February 15. Notification—March 20-April 15. Reply—May 1

Name ________________________________ Phone ____________________
Last First Middle Area Code Number

Current Mailing Address ____
Street City State Zip Code

______________________________ ☐ Please send me a regular application for admission to Northwestern University.
Social Security Number

Secondary School Information

Name of School ______________________________ Year of Graduation ____________

School Address ____
Street City State Zip Code

Rank in class at end of junior year ____________ in class of ____________ Grade Average ____________
position number of students

Test Scores (List the results of any of the following): SAT-Verbal ____________ Math ____________

PSAT/NMSQT Selection Score ________. ACT: Eng ________ Math ________ SS ________ N. Sci ________ Comp ________

Achievement Test: English ________ Math II ________ Chem. ________ Others ____________

Please name one science and one math teacher who have taught you:

____
Name Department Name Department

Years of high school courses you will have completed by graduation:

Course	Years	Honors Course? (Yes or No)	Advanced Placement
English			
Mathematics			
Calculus			
Chemistry			
Biology			
Physics			
Foreign Language			
(List each language separately)			
History/Social Science			
Computer Science			

CANDIDATE INFORMATION

Why is the Integrated Science Program interesting to you?

Please discuss your interest in science and math. What subjects in science-math are especially interesting to you? Have there been any you disliked? (Please discuss.)

Please discuss your long range career and educational goals.

How did you learn about the Integrated Science Program?

Please return this form to: Dr. Robert C. Speed, Director, Integrated Science Program, Locy Hall, Northwestern University, Evanston, Ill. 60201

Appendix B

ISP Curriculum[1]

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[1] The syllabus materials for the ISP courses can be obtained by writing to:

Director, Integrated Science Program
Dearborn Observatory
Northwestern University
Evanston, Illinois 60201

INTEGRATED SCIENCE PROGRAM
COLLEGE OF ARTS AND SCIENCES
NORTHWESTERN UNIVERSITY

The Integrated Science Program is a newly created three-year curriculum that integrates the natural sciences and mathematics and leads to a B.A. in Science. ISP is designed for a small group (30 per year) of academically superior students with career motivation in science and mathematics. The curriculum comprises 24 specially developed courses that are presented by the ISP faculty. The instructors are senior faculty members from science and mathematics departments at Northwestern. ISP courses emphasize sophisticated and rigorous treatments compared to those of most regular departmental offerings; moreover, through coordinated instruction, use of applications, and sequencing of topics, the ISP curriculum attempts to integrate the natural sciences and mathematics and to show that the techniques of one discipline commonly are applicable to others. Beside formal course work and laboratories, ISP includes a regular seminar and frequent visits of small groups of ISP students with Northwestern researchers to give an acquaintance with problems at the forefront and an appreciation of how research is done. Specific contents and sequence of the ISP courses are on a separate enclosure with this letter.

ISP is an experiment in a new pathway of undergraduate science education and, as such, is sponsored by NSF with a 3-year grant. One philosophical concept to be tested in ISP is that there is a strong common base among science disciplines and that the exercise of intellect, analysis, and innovation, and the organization of knowledge are more effectively accomplished by emphasizing the common base rather than the conventions and techniques unique to each discipline. A second idea is that the undergraduate years are the time for students, especially those gifted intellectually, to learn in breadth and depth the full realm of science. The appropriate time for such students to specialize is in graduate school. As a corollary, we regard graduate work at the Ph.D. level as essential for ISP graduates who plan to become practicing scientists. Thus, ISP is designed to provide a comprehensive and rigorous background for graduate studies in all fields of science.

In addition to ISP courses, ISP students take 12 courses outside the natural sciences, selected from University offerings in fine arts, history, philosophy, social science, and foreign language. ISP students and faculty convene about every other week for a special seminar. Speakers are drawn from the Northwestern faculty and from the national scientific community. This year's speaker group includes: Professors Hans Bethe of Cornell, J.Y. Lettvin of M.I.T., Harry Gray of Caltech, W. Haken of University of Illinois, and Bart Bok of University of Arizona.

The ISP quarters consist of a lounge/seminar room, classroom, computer facilities, and director's and secretary's offices. ISP students are issued keys to the building and are encouraged to use the quarters day and night for study, discussion, and collaborative work on problem sets. Our computer equipment currently comprises four terminals on line to the Northwestern CDC 6600. One video terminal together with a monitor is in the classroom for real time problem solving during lectures. We are currently adding an interactive graphics terminal to the facility. As part of the interactive system, we will develop software packages that will permit students to explore extensively the solutions to problems under a variety of conditions and in applications to many fields. We anticipate that interactive computer graphics will allow student inquiry to proceed substantially farther than can be achieved in the normal classroom-homework situation.

The first ISP class began fall '76. Thirty students were selected from a group of about 120 applicants whose credentials were considered satisfactory (year of calculus, excellent achievement record, evidence of strong science-math motivation). The only easily transmitted measures of ability of the first class are average SAT scores: 670v, 750m. Most were in the upper few percent of their graduating class, had grade averages of 3.8 or better, and strong recommendations from science and math teachers. The performance of the majority of these students in their freshman courses in ISP has been commensurate with our goals for an intellectually stimulated, achieving group of undergraduate science majors.

The second class for ISP for fall '77 has just been recruited. From a larger applicant pool this year, the 30 students selected have the following average SAT scores: 683v, 755m. On these bases, we are confident that in years to come ISP will continue to attract students with outstanding academic credentials.

Mark A. Pinsky
Director, Integrated Science Program

INTEGRATED SCIENCE PROGRAM
NORTHWESTERN UNIVERSITY

ISP Curriculum[1]

Core Sequence

MATHEMATICS X1. Taylor's formula, approximation, vectors, vector differentiation, dot and cross products, line integrals, polar coordinates, lines and planes, surfaces, partial derivatives, gradient, chain rule, extremal problems in several variables, implicit functions and their derivatives, Lagrange multipliers, double and triple integrals, cylindrical and spherical coordinates. Principal applications and spherical coordinates. Principal applications in mind: linear and rotational motion, thermodynamics. Text: Calculus, an Introduction to Applied Mathematics, Greenspan and Benney.

COMPUTER X1 Instruction in BASIC and computer access through online systems. Computational problems illustrating approximation, numerical solution of differential equations, trajectories, stepwise integration. Formal material presented as part of Math X1.

PHYSICS X1 Vector kinematics, dynamics, free body problems, momentum, work-energy theorem, energy diagrams, angular momentum, torque, rigid body motion, rotating coordinate systems, central force fields and plane motion, 2-body problems, Kepler's laws, harmonic motion, damped oscillator, special relativity. Laboratory in particle motions and dynamics, collisions, and oscillations. Text: Introduction to Mechanics, Kleppner and Kolenkow.

CHEMISTRY X1 Inorganic Chemistry; equilibria; acids and bases; periodicity; bonding; metal complex chemistry; redox processes; organometallics; chemical kinetics; laboratory work in atomic spectroscopy, acid-base reactions, solubility, calorimetry, and electrochemistry. Text: Basic Inorganic Chemistry, Cotton and Wilkinson.

MATHEMATICS X2 Vector fields, conservative fields, surface area, surface integrals, parametrically defined surfaces, vector operators, divergence theorem, Green's theorem and Stokes' theorem. Principal application: electromagnetic fields. First order differential equations, introduction to numerical methods, statement of existence-uniqueness theorem, linear equations, second order linear equations, linear independence of solutions, Wronskian, constant coefficients, reduction of order, variation of parameters, series solution at ordinary points, infinite series, convergence tests. Principal applications: mechanical and electrical oscillations. Text: Calculus, an Introduction to Applied Mathematics, Greenspan and Benney; Differential Equations and Their Applications, Braun; Differential Equations with Applications and Historical Notes, Simmons.

COMPUTER X2 Batch technique, FORTRAN IV, statements, program structure, variables; arithmetic types, do-loop/continue, freeform read, print/punch, if, subroutines, format, special manipulations, machine dependencies. Lecture and laboratory constitute seven specially scheduled sessions.

PHYSICS X2 Electrostatics, electric field, flux and Gauss' law, electric potential, gradient of potential, divergence theorem, differential form of Gauss' law, DC circuits and Kirchoff's laws, conductors, capacitors, RC circuits. Fields of moving charges, magnetic field, vector potential, Hall effect, electromagnetic induction, self-inductance, displacement current, Maxwell's equations, alternating-current circuits, networks, power and energy in circuits, electric fields in matter, dipole distributions, polarizability tensor, polarized matter, electric susceptibility, dielectrics, magnetic fields in matter, field of a current loop, field of a permanent magnet, ferromagnetism. Laboratory in electrostatics, DC circuits, oscilloscope, e/m ratio of electron, RC circuits. Text: Electricity and Magnetism, Berkeley Physics Series.

CHEMISTRY X2 Concepts of organic chemistry, bonds in organic molecules, stereoisomerism, nuclear magnetic resonance spectroscopy, alkanes, alkenes, alkynes, alkyl halides, alcohols. Text: Introduction to Organic Chemistry, Streitwieser and Heathcock.

MATHEMATICS X3 Power series, Taylor series, regular singular points, Bessel functions. Matrices, Gaussian elimination, matrix inverses, rank, vector spaces, linear independence and dimension, determinants, eigenvalues and eigenvectors, application to solution of linear systems, change of bases, principal axis theorem, application to normal modes of finite discrete systems. Introduction to nonlinear differential equations. Text: Differential Equations and Their Applications, Braun; Differential Equations with Applications and Historical Notes, Simmons; Introduction to Linear Algebra, Zelinsky.

PHYSICS X3 Simple oscillations, the superposition principle, coupled oscillations, vibrating string, resonance, traveling waves, refraction and dispersion, energy flux, reflection and transmission, wave packets, group velocity, waves in two and three dimensions, radiation from a point charge, polarization, polarized states, double refraction, interference and diffraction, Huygen's principle. Laboratory. Text: Wave, Optics, and Modern Physics, Young.

CHEMISTRY X3 Continuation of organic chemistry with focus on carbonyl compounds (aldehydes, ketones, carboxylic acids), carbohydrates, amines, and aromatic compounds. Concepts in synthesis of organic compounds, biorganic chemistry, and applications of infrared, ultraviolet, and mass spectrometry in organic chemistry. Laboratory work in preparations, spectroscopic characterizations, functional group analysis, separations. Text: Introduction to Organic Chemistry, Streitwieser and Heathcock.

MATHEMATICS X4 Orthogonal expansions, Fourier series, orthogonal polynomial expansions and their convergence properties. Partial differential equations, separation of variables; initial-boundary value problems for the LaPlace-diffusion-wave-Schrödinger equations. Solution by transform methods and finite difference approximations. Text: Fourier Series and Boundary Value Problems, Churchill.

CHEMISTRY X4 Physical Chemistry; gas laws and properties, van der Waal's equation; kinetic theory; Boltzmann distribution; critical phenomena; laws of thermodynamics; free energy and spontaneous processes, Clausius-Clapeyron equation; phase equilibria, phase rule; nonequilibrium thermodynamics; Caratheodory principle; information theory; phase transition. Text: Physical Chemistry, Moore.

Advanced Physics Sequence

PHYSICS Y1 Background of quantum mechanics (thermal radiation, photons, wave-particle duality), Bohr atom, Schrödinger equation, time-independent solutions, hydrogen model, probability density, magnetic dipole moments, spm and transition rates, multielectron atoms, optical and X-ray spectra, quantum statistics. Text: Introduction to Quantum Theory, Park.

PHYSICS Y2 Molecules, vibrational-rotational-electronic spectra, solids, band theory, electrical conduction, semiconductors, superconductivity, magnetism of solids. Texts: Introduction to Quantum Theory, Park; Modern Physics, Leighton.

Advanced Mathematics Sequence

MATHEMATICS Y1 Analytic functions of a complex variable, Cauchy's theorem, residue calculus, evaluation of definite integrals. Conformal mapping and its application to potential problems. Laplace transform methods for initial value problems. Asymptotic methods, including Laplace's method and the method of stationary phase. Text: Complex Variables and its Application, Churchill, Brown & Verhey.

MATHEMATICS Y2 Elements of probability theory, binomial and Poisson distributions, conditional probability, Bayes'rule, central limit theorem, interval estimation and hypotheses testing, sequential methods, introduction to stochastic processes. Text: Probability and its Applications, vol. I, Feller.

Advanced Physical Science Sequence

PHYSICAL SCIENCE Y1 Features and motions of the solid earth, gravitation, potential theory, harmonics of earth's gravity and magnetic fields, inversion techniques, mass distribution in earth, heat generation-diffusion-mass convection in the earth, temperature distribution, phase changes, melting and volcanism, elasticity, fracture and earthquakes, elastic waves and ray paths, internal structure of earth, plate tectonics, continental drift. Field study in gravity measurements and data reduction laboratory. Text: Introduction to Geophysics, Garland.

PHYSICAL SCIENCE Y2 Features, motions, and processes of the earth's surface-oceans-atmosphere; equations of motion and continuity in fluid flow, dynamics of the Gulf Stream and other oceanic systems, glaciers and ice ages, chemical cycles at the earth's surface; time in geology; origin of earth; stellar spectra, emission and adsorption; radiative transfer in stellar atmospheres. Text: Physical Oceanography, Defant; Astrophysical Concepts, Harwit.

PHYSICAL SCIENCE Y3[1] Stellar sturcture, equilibrium, equations of state, opacity, energy sources, nuclear reaction rates, energy transport mechanisms; models of homogeneous stars, numerical solutions, Russell-Vogt theorem; mass-luminosity; H-R diagram, stellar evolution; nucleosynthesis, supernovae; compact stars, white dwarfs, neutron stars, black holes. Text: Astrophysical Concepts, Harwit

Life Sciences Sequence

LIFE SCIENCES Y1 Principles of biochemistry; proteins - structure/function relationships, primary-secondary-tertiary structure and evolutionary variability of protein; chemical and cellular immunology; enzyme mechanisms and kinetics; enzyme regulation in the cell; catabolic and biosynthetic properties of cells; membrane structure and transport; macro-molecular assemblies; DNA and chromosome structure; genetic organization and mutation; DNA replication and recombination; transcription and translation of the genetic code. Text: Biochemistry, Stryer; Molecular Biology of the Gene, Watson.

LIFE SCIENCES Y2 Physical and mathematical aspects of biochemistry and molecular biology; protein interaction with small molecules and allosterism; theory of ultracentrifugation; facilitative diffusion, X-ray diffraction studies of DNA fibers; energy calculations for conformations of peptide units; protein tertiary structure determination. Reference works among journal articles.

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[1] Not offered.

LIFE SCIENCES Y3 Cell biology and physiology; eucaryotic cell morphology including organelle structure-function relationships and structures for interactions between cells; cellular energetics and compartmentalization of biochemical activities; kinetics of diffusion and non-electrolyte transport; cell surface interactions; molecular embryology and control of gene function; mitosis and the control of cell proliferation; cellular immunology muscle proteins and contractile systems; nerve and synapse physiology, resting and action potentials, ion transport equations. References: *Molecular Biology of the Gene*, Watson; *The Physiology of the Excitable Cells*, Aidley; *Functions of Biological Membranes*, Davies.

LIFE SCIENCES Y4 Biology of perception and memory from tutorial format; neuroanatomy and neurophysiology of relevant part of nervous system; elements of communications theory; theories of perception based on Fourier analysis; molecular bases for memory based on directed synthesis of proteins and nucleic acids and their regulation. *References*: *Remarks on the Visual System of the Frog*, Lettvin; *Pattern Recognition Techniques*, Ullman; *Current Biochemical Approach to Learning and Memory*, Essman and Nakajima.

LIFE SCIENCES Y5 Population biology and evolutionary theory; integration of theoretical, experimental, and field aspects of contemporary population and evolutionary biology; maintenance of genetic variation; causes of succession; mathematical models of topics addressed, for example, dynamics of interacting species and analysis of gene/frequency change. Laboratory: protein identification by gel electrophoresis; field work. References: *An Introduction to Population Genetics Theory*, Crow and Kimura; *Theoretical Ecology*: *Principles and Application*, May.

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[1] The complete syllabus materials for the ISP courses can be obtained by writing to:

Director, Integrated Science Program
Dearborn Observatory
Northwestern University
Evanston, Illinois 60201

ISP CURRICULUM

	Fall Quarter	Winter Quarter	Spring Quarter
Year One	Math X1 Multidimensional calculus Physics X1 Mechanics Chemistry X1 General chemistry Computer X1 Liberal Arts	Math X2 Vector differential operators and ordinary differential equations Physics X2 Electricity and magnetism Chemistry X2 Organic chemistry Computer X2 Liberal Arts	Math X3 Systems of differential equations, linear algebra, and infinite series Physics X3 Waves and oscillations Chemistry X3 Organic chemistry Liberal Arts
Year Two	Math X4 Boundary value problems Physical Science Y1 Physics and chemistry of earth (the solid earth) Chemistry X4 Physical chemistry Liberal Arts	Math Y1 Functions of a complex variable Physics Y1 Quantum mechanics Life Sciences Y1 Principles of biochemistry Liberal Arts	Math Y2 Probability and statistics Physics Y2 Solid-molecular-atomic physics Life Sciences Y2 Physical and mathematical biochemistry Liberal Arts
Year Three	Physics Y3 High energy physics Life Sciences Y3 Cell biology and physiology Liberal Arts Liberal Arts	Physical Science Y2 Oceans and Atmospheres; Astrophysics Life Sciences Y4 Biology of perception and memory Liberal Arts Liberal Arts	Physical Science Y3[a] Astrophysics Life Sciences Y5 Population biology and evolutionary theory Liberal Arts Liberal Arts

[a] Not offered.

X courses are core sequence
Y courses are advanced sequences

Appendix C

ISP Course Evaluation Questionnaire

ISP Summary Questionnaire

Name______________________________

ISP COURSE EVALUATION

We are interested in your assessment of the ISP curriculum. Please complete one of these forms for each ISP course taken during the past quarter. Thank you for your cooperation.

Instructor's Name:

Course (Name/Number):

Date (Quarter, Yr.):

You may add comments beneath the question, or at the end of the questionnaire, if you wish.

Use the following scale in answering each question. CIRCLE ONE CHOICE ONLY on each line.

1. Strongly Agree
2. Agree
3. Neutral
4. Disagree
5. Strongly Disagree

1. The course material was presented on too difficult a level for me. 1 2 3 4 5
2. I feel I learned a lot from taking this course. 1 2 3 4 5
3. The teacher had an excellent knowledge of the subject. 1 2 3 4 5
4. The teacher made good use of examples and illustrations. 1 2 3 4 5
5. The general attitude and preparation of fellow students contributed to the value of the class. 1 2 3 4 5
6. The teacher was readily available after/outside of class for discussion of course material. 1 2 3 4 5
7. The teacher had sufficient evidence in terms of class participation exams, and/or written work, on which to base evaluation of a student's performance. 1 2 3 4 5
8. I am glad I took the course. 1 2 3 4 5
9. The teacher's discussion of the course material was intellectually stimulating. 1 2 3 4 5
10. The teacher communicated his/her ideas in a clear and organized manner. 1 2 3 4 5
11. I would have liked the lectures or discussions to have concerned themselves more with the readings. 1 2 3 4 5
12. Considering the size of the class, the teacher's policy toward discussing questions was satisfactory. 1 2 3 4 5

CONTINUE ON OTHER SIDE

13. The book(s) were good choices for the course. 1 2 3 4 5

14. The teacher showed enthusiasm for the subject and teaching. 1 2 3 4 5

15. The classes were to the point and time was well spent. 1 2 3 4 5

16. The grading procedure was fair and impartial. 1 2 3 4 5

17. This course required a lot of time. 1 2 3 4 5

18. The papers, if any, covered important aspects of the course material. 1 2 3 4 5

19. The tests, if any, covered important aspects of the course material. 1 2 3 4 5

20. The tests, if any, had questions which were too general and/or ambiguous. 1 2 3 4 5

21. For me, the pace at which material was covered was .....

1. Much too fast 2. Too fast 3. About right 4. Too slow 5. Much too slow

22. Was the class site satisfactory for the method of conducting the class?

1. Yes, all of the time; 2. Yes, most of the time; 3. No, class too large;

4. No, class too small; 5. Class size not important.

23. I normally attend class:

1. All of the time; 2. Most of the time; 3. Half of the time;

4. Sometimes; 5. Hardly ever.

24. What do you feel was the main source of your learning in this course? CIRCLE ONE.

1. Almost all from the teacher and his/her lectures and effort.
2. Almost all from reading the book(s).
3. Equally from both teacher and book(s).
4. From independent study.
5. From quiz sections, labs, or small group discussions.
6. From writing paper(s) or preparing for exams, quizzes, etc.

25. The teacher was actively helpful when students had difficulty. 1 2 3 4 5

26. The teacher was inflexible. 1 2 3 4 5

27. The objectives of this course were never explicitly stated. 1 2 3 4 5

28. The readings were difficult. 1 2 3 4 5

29. This course did not prepare me to solve problems in this subject area. 1 2 3 4 5

CONTINUE ON NEXT PAGE

30. This course was related to my other courses. 1 2 3 4 5
31. This course dealt with issues I think are relevant. 1 2 3 4 5
32. This course built on my previous knowledge. 1 2 3 4 5
33. This course was challenging. 1 2 3 4 5
34. I had skills that helped with the course. 1 2 3 4 5
35. This course was mostly a repeat. 1 2 3 4 5
36. The homework was useful. 1 2 3 4 5

Quiz/Lab Section (37-42)

If you did not have any quiz or lab sessions, please skip this section

37. The quiz or lab instructor was able to answer the student's questions adequately. 1 2 3 4 5
38. The quiz or lab instructor stimulated and maintained discussion. 1 2 3 4 5
39. The quiz or lab instructor told students when they had done well. 1 2 3 4 5
40. The quiz sections or labs were useful. 1 2 3 4 5
41. The quiz or lab instructor displayed enthusiasm for the course. 1 2 3 4 5
42. The quiz or lab instructor graded my work fairly. 1 2 3 4 5

Computer Instruction (43-47)

If you did not have any computer instruction, please skip to question 48.

43. The amount of time spent on computer instruction was sufficient. 1 2 3 4 5
44. I feel the formal insturction on computers was inadequate. 1 2 3 4 5
45. I feel more computer assignments are needed. 1 2 3 4 5
46. This course has prepared me to solve problems on the computer. 1 2 3 4 5
47. This course has prepared me to easily go further in computer programming. 1 2 3 4 5

Essay Questions (48-50)

48. Why was this a good course, a bad course, an in-between course?

49. How could the instructor best improve his/her course and teaching?

50. Please add any other comments:

Name______________________________

ISP Summary Questionnaire

We are interested in how successful you feel the ISP faculty has been in creating an integrated science program. Please indicate how strongly you agree or disagree with each of the following statements.
Answer using the following scale:

1	2	3	4	5
strongly agree	agree	neutral	disagree	strongly disagree

_____1. The material in mathematics was directly useful in physics.

_____2. The material in mathematics was directly useful in chemistry.

_____3. The material in physics was directly useful in mathematics.

_____4. The material in physics was directly useful in chemistry.

_____5. The material in chemistry was directly useful in mathematics.

_____6. The material in chemistry was directly useful in physics.

_____7. The teacher in mathematics clearly coordinated his/her presentation of the material with the work done in physics.

_____8. The teacher in mathematics clearly coordinated his/her presentation of the material with the work done in chemistry.

_____9. The teacher in phsyics clearly coordinated his/her presentation of the material with the work done in mathematics.

_____10. The teacher in physics clearly coordinated his/her presentation of the material with the work done in chemistry.

_____11. The teacher in chemistry clearly coordinated his/her presentation of the material with the work done in mathematics.

_____12. The teacher in chemistry clearly coordinated his/her presentation of the material with the work done in physics.

_____13. The teachers in mathematics and physics coordinated their homework assignment and examinations to lessen the amount of work that students would have to do at any one time.

_____14. The teachers in mathematics and chemistry coordinated their homework assignments and examinations to lessen the amount of work that students would have to do at any one time.

_____15. The teachers in physics and chemistry coordinated their homework assignments and examinations to lessen the amount of work that students would have to do at any one time.

_____16. The ISP program has shown me how the different scientific disciplines are interrelated.

_____17. The ISP faculty have successfully created an integrated science program.

Appendix D

ISP Student Survey

Name ______________________________

ISP Student Survey

Please feel free to elaborate on your answers.

A. We are interested in your usage of various facilities and opportunities provided by the community, the university, and the ISP program. On the average, how many times per week do you do each of the following?
Answer using the following scale:

0 = none
1 = one
2 = two
3 = three
4 = four or more

_____1. enter the library (including its branches)
_____2. enter Norris University Center
_____3. use Patten Gym or the Blomquist Recreation Building
_____4. attend a musical or theatrical event
_____5. attend a movie
_____6. attend a non-class speech or lecture (excluding ISP seminars)
_____7. enter Vogelback Computing Center
_____8. use the ISP computer terminals
_____9. enter the ISP lounge during the day (i.e., before 6 P.M.)
____10. enter the ISP lounge in the evening (i.e., after 6 P.M.)

B. We are interested in how often you have had various types of interactions with your instructors. How many times during the past quarter have you done each of the following?
Answer using the following scale:

0 = none
1 = one
2 = two
3 = three
4 = four or more

_____1. met with a course instructor to discuss your progress in his or her course

_____2. met with a faculty member (other than your advisor) to discuss your overall progress and goals

_____3. met with your educational advisor

_____4. received feedback from an instructor which made you feel that you might become a creative or productive worker in his or her field

C. Listed below are some statements which could be made about university professors. How well does each statement describe the ISP instructors you have had? Answer using the following scale:

1	2	3	4	5	6	7
not at all descriptive						very descriptive

_____1. The instructors are genuinely interested in students and their problems.

_____2. The instructors get to know few of their students by name.

_____3. The instructors grade students more on the basis of extraneous or irrelevant factors than on the quality of their work.

_____4. The instructors challenge students to produce to the limit of their intellectual and creative capacities.

_____5. The instructors are very open to complaints and suggestions from students.

D. Listed below are several terms and phrases which could be used to describe a university's psychological climate or atmosphere. How well does each term or phrase describe the atmosphere in ISP and/or the attitudes of its students? Answer using the following scale:

1	2	3	4	5	6	7
not at all descriptive						very descriptive

_____1. intellectual

_____2. snobbish

_____3. social

_____4. practical-minded

_____5. friendly

_____6. lots of group spirit

_____7. happy

_____8. depressed

_____9. genuine affection for the school

____10. much competition for grades

____11. high level of academic honesty and integrity

____12. high academic standards set by the faculty

____13. high academic standards set by the students for themselves.

E. Some of your time outside of class is spent on academic activities (e.g., doing course assignments and studying for exams). Other time is spent on non-academic activities (e.g., partying and eating).

1. What percentage (0 to 100%) of your awake time (i.e., time when you are not sleeping) would you say you spend in class? _____%
2. What percentage of your awake time would you say you spend on academic activities outside of the classroom? _____%
3. (a) Of the three people with whom you are most likely to be when you are engaged in academic activities outside of the classroom, how many are in ISP? 0 1 2 3
   (b) What percentage of your academic-related time outside of the classroom would you say you spend with other ISP students? _____%
   (c) How useful have you found your interactions with other students in terms of increasing your own comprehension of the material in your math and science courses? (Circle a number)

1 2 3 4 5 6 7
not at all useful very useful

4. (a) Of the three people with whom you are most likely to be when you are engaged in non-academic activities, how many are in ISP? 0 1 2 3
   (b) What percentage of your non-academic time would you say you spend with other ISP students? (Ignore the time you spend sleeping in making this estimate.) _____%

F. (For first-quarter freshmen only)

1. Were you given 3-year status when you entered NU? Yes No
2. If yes, how much did this influence your decision to enroll in ISP? (Cirlce a number)

1 2 3 4 5 6 7
not at all very much

G. 1. Would you like ISP to be spread over 4 rather than 3 years?

1 2 3 4 5 6 7
definitely not definitely yes

2.a. Are you considering spending a fourth year at NU?

1 2 3 4 5 6 7
definitely not definitely yes

b. If you do spend a fourth year here, what do you think you will study? (Leave blank if not applicable)

3.a. Are you considering getting an advanced degree?

1 2 3 4 5 6 7
definitely not definitely yes

b. If you do get an advanced degree, what fields might you study, and what universities might you attend? (Leave blank if not applicable)

4. What, if any, science-related careers are you considering pursuing?

5. What, if any, non-science careers are you considering purusing?

6. How enthusiastic are you about pursuing a career in science?

1 2 3 4 5 6 7
not at all very much

H. ISP probably appeals to different people for different reasons. How much does each of the following aspects of ISP contribute towards making ISP a satisfying educational experience for you?
Answer using the following scale:

1 2 3 4 5 6 7
not at all very much

_____1. ISP lounge
_____2. ISP seminars
_____3. lab visits
_____4. computer facilities
_____5. computer instruction
_____6. association with intelligent students
_____7. association with students interested in science
_____8. potential for earning a degree in 3 years
_____9. potential for earning 2 degrees in 4 years
____10. avoidance of arbitrary choice of a traditional major
____11. curriculum encompassing all the natural sciences and math
____12. curriculum integrating math and the natural sciences
____13. accelerated and rigorous courses
____14. small class size
____15. use of NU's best faculty
____16. ISP advising system
____17. potentially greater appeal of ISP to graduate schools

I. How satisfied are you with each of the following aspects of the ISP program? Answer using the following scale:

1 2 3 4 5 6 7
very dissatisfied — very satisfied

_____1. degree of emphasis on the relationships among the basic sciences and mathematics
_____2. degree of emphasis on interdisciplinary subjects
_____3. degree of exposure to new and challenging concepts
_____4. opportunity to thoroughly master the basics
_____5. size of ISP classes
_____6. difficulty level of ISP courses
_____7. degree of freedom in course selection
_____8. relevance of courses to your interests
_____9. amount of interaction with other ISP students
____10. amount of interaction with non-ISP students
____11. amount of interaction with ISP faculty
____12. amount of interaction with other NU faculty
____13. quality of advise and guidance received from faculty
____14. physical facilities of the ISP program
____15. number of outlets for creative activities
____16. amount of work required

J. 1. In general, how satisfied are you with your experience in ISP?

1 2 3 4 5 6 7
very dissatisfied — very satisfied

2. How much have you enjoyed the experience of being in ISP?

1 2 3 4 5 6 7
not at all — very much

3. How would you rate the amount of time required for ISP course assignments?

1 2 3 4 5 6 7
much too little — much too much

4. Think about what you hoped to learn from your math and science courses this year. How does the amount of knowledge you've gained so far compared with what you hoped you would have learned by now?

1 2 3 4 5 6 7
I learned much less than I had hoped — I learned much more than I had hoped.

5. How easy or difficult has it been for you to manage your time during the past quarter?

1 2 3 4 5 6 7
very easy — very difficult

6. How do you think ISP compares with other Northwestern science programs?

	1	2	3	4	5	6	7
ISP is much worse							ISP is much better

7. Please suggest ways in which you think the ISP program could be improved.